The
GEOGRAPHICAL JOURNAL

Vol XCI No 5 R.G.S. *May 1938*

DESICCATION AND THE WEST AFRICAN COLONIES

BRYNMOR JONES

THE question of the progressive desiccation of Africa and the consequent expansion of the desert areas has received considerable attention in the scientific literature dealing with the continent. In West Africa it is the region comprising the Sahara and the western Sudan which has been most closely studied from this point of view. It is widely believed that this region is becoming increasingly arid and that the populous countries between the Sahara and the humid belt bordering the Gulf of Guinea are in process of degeneration into an inhospitable wilderness. Important contributions to this subject have been made in recent years by Professor E. P. Stebbing,[1] who takes a more gloomy view of the future of West Africa than any of his predecessors in this field. He believes that the fertility of the farmlands of the northern provinces of Nigeria is threatened by the encroachment of sand from the Sahara and that the natural vegetation is dying out and being replaced by drier types owing to the drying up of the water supplies. The northern provinces of Nigeria have a population of eleven and a half millions, with an average density of 40·58 to the square mile. They form a rich agricultural region with an export trade in groundnuts, cotton, and hides and skins which is a most important factor in the economic life of the Protectorate. In 1936 the export of groundnuts alone was 218,389 tons, with a cash value of £2,847,414. The groundnuts are grown in the most northerly districts, precisely those which, according to Professor Stebbing, are in immediate danger from the advancing Sahara. The destruction of these districts would have serious consequences for Nigeria, and the note of warning sounded by Professor Stebbing cannot be ignored. There are however observers with considerable experience in West Africa who are not in accord with many of Professor Stebbing's conclusions. The problem of desiccation was recently investigated by an Anglo-French Forestry Commission, to which the present writer was attached, and which toured northern Nigeria and the French Niger

[1] E. P. Stebbing, "The threat of the Sahara," *J. Afr. Soc., Lond.* May 1937, and "The encroaching Sahara: the threat to the West African colonies," *Geogr. J.* 85 (1935) 506–24.

Colony from December 1936 to February 1937. An attempt is made in this paper to review the question of desiccation in West Africa in the light of the most recent evidence, and to examine the problem particularly as it applies to Nigeria, the country which most interested Professor Stebbing.

The theory of progressive desiccation

There is ample evidence that the arid regions of West Africa were at one time relatively well watered. In the Sahara and the western Sudan there are extensive systems of old river valleys radiating from the mountain masses. Many of the valleys are several miles in width and some of them can be traced for hundreds of miles. These valleys must have been excavated at a time when the region received a relatively high rainfall. To-day they either contain no surface water or are traversed by insignificant streams many of which flow only for brief periods during the rains. The greater part of the region has a deep covering of sand, and rounded hills of drifted sand, obviously formed by wind action, are prominent features of the landscape in many areas and frequently obstruct the beds of the old valleys. Palaeolithic and Neolithic implements and weapons are found in places which are remote from any source of water and in which human habitation is now impossible. Extensive sheets of surface ironstone (laterite) occur in the western Sudan in areas where the material cannot form under the present climatic conditions. The North African elephants, which were used by the Carthaginians in the Punic Wars, and the crocodiles and fish which occur in the Sahara and the western Sudan in lakes remote from other surface water appear to be creatures of Central African origin which became isolated by a regional desiccation.

There is general agreement amongst competent observers that the old valley systems of the Sahara and the western Sudan were excavated early in the Quaternary period. It is obvious that the region has become much more arid since that time. A similar change of conditions has taken place in East Africa and there it has been shown that the decrease of humidity has not been a continuous process but that between the early Quaternary and the present day there have been several major changes of climate.[1] As far as West Africa is concerned however the author most often quoted is Hubert, who believes that the change from the pluvial conditions of the early Quaternary to the more arid conditions of the present day has been brought about by a process of progressive desiccation.[2] The theory is strongly contested however by many experienced scientific observers. These are of the opinion that West Africa, like East Africa, has experienced major climatic changes and that there has been since the early Quaternary at least one period during which desiccation was much more severe than it is to-day.

A deep mantle of sand covers a large proportion of the western Sudan. As it is frequently seen banked against and even overtopping rocky hills and accumulated into dunes, it is obvious that wind played a part in its distribution. In some areas even outside the present limits of the desert, as for instance in the Manga, the sand occurs in vast fields of closely packed dunes, now

[1] Wayland, Geological Survey of Uganda Ann. Report, 1932.

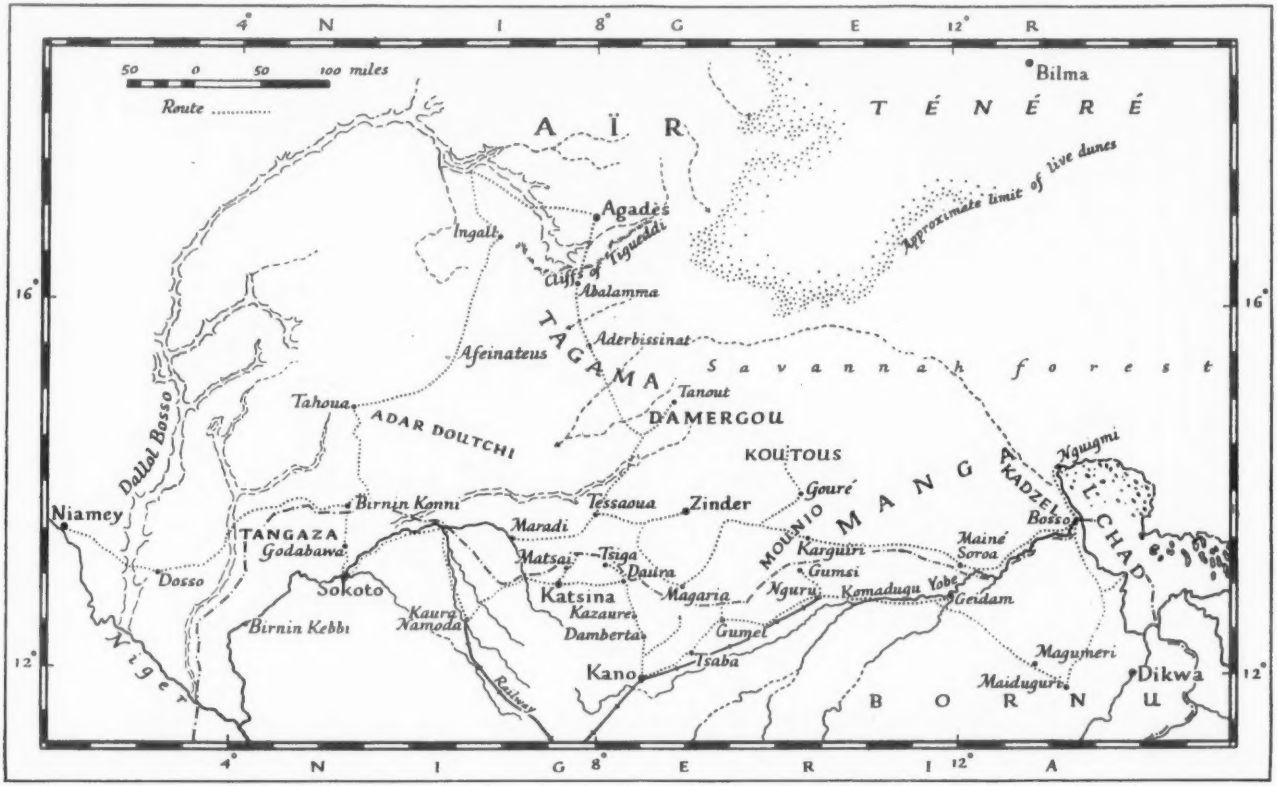
[2] H. Hubert, "Le desséchement progressive en Afrique occidentale française," *Bull. Com. A.O.F.* 1920.

stationary and grassed over. Dune formation on such a scale could have taken place only under conditions of extreme aridity, such as those which still prevail in the Sahara, and during the time that the dunes were being formed vegetation must have been absent or very sparse. Bagnold states that in the Libyan Desert the formation of true dunes appears to cease at a point about 100 miles from areas in which the rainfall is frequent enough to support grassy vegetation in the sand.[1] The dune fields within the Sahara, such as those of the Ténéré, are practically bare of vegetation, and there the sand is "live" and dune formation is still taking place. In nearly the whole of the western Sudan however the sand is now anchored by forest and grass, and the dunes, so far from being in process of formation, are actually being eroded by the annual rains. One is therefore led to conclude that there has been in the past an arid period sufficiently severe to permit the formation of dunes in the western Sudan and that this has been succeeded by a return of humidity which has caused the fixation of the dunes by vegetation.

Since anchored sand-dunes occur in many of the old Quaternary river valleys it follows that the period of aridity intervened between the early Quaternary and the present day. Most of the evidence which has been advanced to support the theory of progressive desiccation is due to the regional desiccation during this arid period. It was probably then, for instance, that the crocodiles of the desert lakes and the North African elephants were cut off from their kindred to the south. It is a well-known historical fact that the Carthaginian elephant was inferior in size and strength even to the Indian elephant, and the crocodiles also are of stunted appearance. The creatures are of degenerate types and must therefore have become isolated at a distant period. As regards the surface ironstone, most of this material probably dates from the end of the Tertiary period. The Quaternary valleys were excavated through the ironstone into the sediments below and ironstone-capped hills, isolated by erosion, occur in the middle of the valleys. Sandford considers that the laterite in the Libyan Desert is not younger than the close of lower Palaeolithic times.[2] In many areas in the western Sudan sheets of surface ironstone are covered with drifted sand which is now anchored by vegetation. There has evidently been more than one marked change of climate since the ironstone was formed and the presence of the material in arid areas cannot therefore be accepted as evidence of progressive desiccation.

During the period when conditions of extreme aridity prevailed in the western Sudan the former river valleys were partially or completely blocked by accumulations of sand. Professor Stebbing refers to pools occurring in unexpected places, which he was informed were probably the remains of old rivers now reduced to these patches above ground. These pools owe their existence to the flat topography and to the interruption of the ancient drainage lines. The increase of rainfall which succeeded desiccation has not been great enough to enable the streams to repossess completely the former river valleys. Pools, both permanent and seasonal, are very common throughout the western Sudan in areas remote from drainage channels and without associated riverain deposits. In Nigeria they are known by the Hausa name of *tabki*

[1] R. A. Bagnold, "A further journey in the Libyan desert," *Geogr. J.* 82 (1933) 125.
[2] *Geogr. J.* 82 (1933) 222.



Nigeria and the French Niger Colony. The route shown is that followed by the Anglo-French Forestry Commission, 1936–37

(pl. *tabkuna*). Any surface depression tends to cause the formation of a *tabki*. During the rains water percolating down the slopes of the depression carries silt and clay in suspension. In the early stages of *tabki*-formation much of this material is carried down into the subsoil, but some of it is filtered out at the surface and forms a pellicle of fine material at the bottom of the depression. The downward percolation of subsequent rains is retarded by this fine-grained film and consequently much of the water is evaporated and its content of clay and silt deposited on the surface. In this way a layer of fine material formed on the floor of the depression prevents or retards the percolation of the rain-water, which therefore remains as a pool. During heavy storms coarser material is washed down the slope and is represented in the *tabki*-bed profile by streaks and lenticles of grit. The pools are of great importance to the local people, who increase the water-holding capacity of the bed by trampling it with their cattle. When the water surface is reduced in the dry season it exposes a bare expanse of clay which develops polygonal cracks under the drying rays of the sun. The pools are ringed by a fringe of vegetation which is generally of a moister type than that on the surrounding more elevated ground.

Tabkuna tend to get filled up and to be converted into flat areas with an indurated surface from which run-off is high. The water either percolates into the surrounding sand or drains away to accelerate *tabki*-formation in a neighbouring hollow. If this process continues for a sufficient length of time much of the rainfall tends to find its way along indurated surfaces to one of the drainage channels. When the clay pan is no longer subject to seasonal flooding it weathers and crumbles and becomes mixed with sand carried over the bare surface by the wind or by animals. Eventually grass establishes itself and is followed by scrub. All stages of this process may be seen in northern Nigeria. A pit sunk in a clayey flat or in the bed of a *tabki* usually penetrates through the surface clay into sand, except, of course, where the clay is directly derived from the weathering of the underlying rock. The alluvial plains of Dikwa are flooded each year and yield heavy crops of a species of guinea-corn. When the crop has been reaped a shaft is sunk through the clay into the loose sand underlying it. A large cavern is excavated in the sand and corn is packed into it. The clay is then replaced and well beaten down. Corn stored in this way will keep in good condition for years although the ground surface is inundated every wet season. It is common knowledge that in a normal profile the subsoil tends to be heavier than the top soil because percolating rain-water carries down the finer particles. Where clay overlies sand it is an indication that water has flooded an area which was previously well drained. The occurrence of clay over loose sand is too widespread in the western Sudan to be without significance, and it supports the conclusions drawn from the growth of vegetation on the sand dunes. The sequence of events which it suggests is the resumption of rainfall over a region with a sandy irregular surface such as would be produced under conditions of great aridity.

Several workers in French and British West African colonies have pointed out that the theory of progressive desiccation is not compatible with the evidence. Chudeau considered that the area of maximum desiccation was formerly the Sahel, the region lying immediately south of the present limits

Nigeria and the French Niger Colony. The route shown is that followed by the Anglo-French Forestry Commission, 1936–37

of the Sahara, and that there was subsequently a displacement of the desert towards the north.[1] From his work in northern Nigeria Falconer concluded that the climatic conditions immediately preceding those of the present day were characterized by severe desiccation during which desert conditions extended much farther south than they do now, and that the present regime of periodic rains represents a return to more humid conditions.[2] Gautier supports Falconer's view and considers that there is some evidence that desert conditions formerly prevailed as far south as the coast of French Guinea.[3] Monod[4] and Sandford[5] are of the opinion that desiccation became most severe in the middle and upper Palaeolithic and forced Palaeolithic man to abandon areas which had previously been habitable. Urvoy has recently examined the terraces along the old valleys in Niger Colony and he considers that several oscillations of climate have taken place in West Africa since the commencement of the Quaternary, the last major change being a return to relatively humid conditions.[6] Urvoy believes that there has been some increase of aridity since this last change took place but that the climate has now been stable for a very long time and that it is not progressively deteriorating.

The trend of conditions at the present day

It may be said that most investigators are now agreed that there has been more than one change of climate in West Africa since the beginning of the Quaternary period and that the last major change has been one towards more humid conditions. As far as the future of the West African colonies is concerned however it is the trend of conditions at the present day which is of importance. It is doubtful if the term "arid" is applicable to any of the British colonies in West Africa, since even the driest part of them (around Lake Chad) receives a mean annual rainfall of 15 inches. Nevertheless, the northern districts of Nigeria have experienced severe famines after years of deficient rainfall and any progress of desiccation would have serious consequences.[7] For the French territories in the truly arid region around the Sahara the consequences would be disastrous. As regards the trend of conditions at the present day there is considerable difference of opinion, and even those who believe that desiccation is now in progress differ in the causes to which they assign the process.

Hubert states that desiccation has been observed to progress since the French occupation in West Africa and that the deterioration of conditions was particularly rapid during the first twenty years of this century. He believes that the principal factor has been a progressive diminution of the rainfall. Gautier has paid considerable attention to this question.[8] He points out

[1] R. Chudeau, 'Sahara soudanais,' 1909.

[2] J. D. Falconer, 'Geology and geography of northern Nigeria,' 1911, p. 214.

[3] E. F. Gautier, 'L'Afrique noire occidentale,' 1935, p. 28.

[4] T. Monod, "Travels in the western Sahara," *Geogr. J.* 87 (1936) 534–39.

[5] *Loc. cit.*, p. 222.

[6] Y. Urvoy, "Terrasses et changements de climat quaternaires à l'est du Niger," *Ann. de Géographie*, No. 249, 1935.

[7] G. T. Renner, "A famine zone in Africa: the Sudan," *Geographical Review* 16 (1926) 583–96.

[8] E. F. Gautier, 'Sahara: the great desert,' 1935, p. 95.

that nowhere on the globe does history go so far back into the past as it does in the countries along the northern front of the Sahara. Yet historical and archaeological research has failed to produce any conclusive evidence that there has been any change in the climate of this region since the dawn of history. Gautier believes however that the quantity of superficial water in the Sahara and the western Sudan is growing less. He attributes this to a progressive decrease in the volume of water carried into the drier regions by rivers originating in the more humid regions to the south, owing to the continued deposition of alluvium in the lower reaches and to river capture. Stebbing believes that desiccation is being caused principally by man who, by destroying the forests, is promoting erosion and sand drift and lowering the water-table. He states that Kano is in danger of being overwhelmed by the Sahara within the next fifty years, or less.[1]

If desiccation is increasing and menacing the future of the West African colonies it should reveal itself in one or more of the following ways: the encroachment of sand; the retrogression of the vegetation; the reduction of rainfall; the lowering of the water-table, leading to the failure of wells; the shrinkage of streams and lakes; and the migration of the population. In the succeeding pages the evidence collected on these points by the Anglo-French Forestry Commission is recorded and examined in order to determine whether desiccation is now in progress and, if so, the agencies which are causing it.

The encroachment of sand.—The sandy surface mantle which covers most of the western Sudan is derived principally from the weathering of the Cretaceous and Tertiary sediments which underlie a considerable proportion of the region. The weathered material has been re-sorted and distributed by the elements and in places it overlies smooth surfaces of crystalline rock. The covering of drift is in general thickest over the sedimentary rocks from which it was derived and which consist largely of sandstones and therefore allow ready percolation of the rainfall. The crystalline rocks are impervious to water and consequently the drift which overlies them is readily eroded by storm waters. The present period is one of erosion, not of accumulation, and over wide areas of crystalline rock the former sandy cover has been almost completely removed. This fact is sometimes a useful guide in the preparation of a geological map. This difference in the distribution of the surface sand led Professor Stebbing to make the surprising statement that the town of Maradi is on the edge of the desert. Professor Stebbing travelled to Maradi from Katsina and was probably impressed by the increase in the quantity of surface sand. The first part of his route was over crystalline country with little or no sand, but approaching Maradi the road enters an area underlain by sandstones. The increase of sand near this town indicates therefore not that one has reached the desert but that one has crossed a geological boundary.

Throughout his paper [2] Professor Stebbing makes frequent reference to encroaching sand which, he believes, is threatening northern Nigeria on its southward march from the Sahara. On his map he indicates the present advance of the sand as a line running from Ansongo on the Niger through Tahoua, Zinder, and Bosso to Lake Chad. He states that within the boundaries

[1] E. P. Stebbing, 'The forests of West Africa and the Sahara,' p. 10.
[2] E. P. Stebbing, "The encroaching Sahara," *Geogr. J. loc. cit.*

of Nigeria sand invasion is already evident and that in Katsina it has reached a serious stage. The observations of the Anglo-French Forestry Commission led them to conclude, on the contrary, that encroaching sand is not a serious factor in either northern Nigeria or Niger Colony. The Commission found that the most southerly of the masses of moving sand of the Sahara was that of the Ténéré, east of Agadès. The approximate limit of these live dunes is shown on the accompanying map. Its nearest point to Nigeria is 150 miles north of the frontier. Between the Ténéré and Nigeria the sand is in general well fixed by vegetation; it is not moving and its form is being modified only by erosion. This is the *erg mort* of French authors. Within this region there are a few live dunes the nearest of which to Nigeria are in the Manga. The Manga is a sharply undulating region of anchored sand-dunes broken by numerous disconnected flat-bottomed valleys in many of which there are salt lakes. In the southern fringe of the Manga, where the dunes are most prominent, there is very little tree growth except in the valleys, but the sand is firmly fixed by a growth of *gamba* grass (*Andropogon gayanus*). This portion of the Manga extends into British Bornu and its southern limit is marked on the district maps by a line labelled "Limit of Bush." This has led many people to suppose that the line marks the edge of the desert. Actually, the grassy Manga area is surrounded on all sides by wooded country. The paucity of trees on this portion of the Manga has not yet been satisfactorily explained. It is apparently not due to the disappearance of a former forest cover since there are no dead or dying trees. Aubréville suggests that the dunes were formed on the bed of a former salt lake and that the sand still contains a sufficient proportion of salt to hinder tree growth.[1] It is possible however that the explanation is to be found in the very free drainage of this exceptionally sandy area.

In the Manga country between Mainé Soroa and Karguiri three small live dunes were seen by the Commission. These were beside villages, and it seems reasonable to suppose that it is through the action of man and his stock that the normal covering of grass has been removed. Each of the live dunes was on the eastern slope of a valley and so the movement of the sand before the north-east wind was assisted by gravity. No live dune was seen on the western side of a valley, where the slope would hinder the advance of the sand and give the grass a better chance to re-establish itself after it had been removed by farming or grazing. One live dune of considerable size lies 9 miles south-west of Nguigmi. This was not examined by the Commission, but the local people stated that the dune had shown no appreciable displacement within living memory.

In the Tagama between Aderbissinat and the cliffs of Tigueddi and again between Ingall and Efeinateus, sand tends to form small mounds in the lee of trees and other obstacles. This is particularly noticeable along the road, where the continual passage of people and stock keeps the surface sand in a loose condition. This area is obviously one in which the sand is incompletely fixed. The mean annual rainfall is only about 8 inches, and it is probable that in the dry seasons the sand is locally displaced by the wind and that during the rains the mounds are eroded and dispersed.

[1] A. Aubréville, "Les forêts de la colonie du Niger," *Bull. Com. A.O.F.* 1936.

The term "encroachment of the Sahara" is an unhappy one since it implies a southward march of the desert sand. It has been shown that the nearest of the live dunes of the Sahara lie more than 150 miles north of the Nigerian frontier so that, although it is known that sand can cover great distances in favourable circumstances, the prospect of the encroachment of the Sahara sand is a very remote one. The dunes of the Ténéré presumably progress towards the south-west under the influence of the north-east wind but their rate of advance has not been measured. Beadnell states that in the Kharga small isolated dunes progress at the rate of 15 metres a year, while larger dunes advance more slowly. Moving at the rate of 15 metres a year the first live dunes of the Ténéré would not reach the borders of Nigeria for about 17,000 years. It is obvious moreover that under the present climatic conditions the sand will become fixed with vegetation before it gets very far. Professor Stebbing proposes as a barrier against the Sahara the reservation of a belt of forest running through Birnin Konni, Katsina, Nguru, and Geidam to Lake Chad. Nigeria is not in danger from Sahara sand but, if it were, a barrier already exists in the form of a belt of forest about 100 miles wide consisting largely of *Commiphora Africana* which stretches from north of Tahoua to beyond Gouré, considerably nearer the desert than the line suggested by Professor Stebbing. A more suitable term for the process Professor Stebbing has in mind would be "expansion of desert conditions," since any progress of desiccation would reveal itself not so much in the accelerated advance of the desert dunes as in the death of the vegetation of savannah and steppe and the subsequent shifting of sand in areas where it had previously been anchored. The western Sudan has already experienced at least one period of desiccation and the sand which was drifted by the wind was largely of local origin. The sand which was banked against the crystalline hills of Mounio, for instance, shows from its colour that it was derived from the pink grits of Koutous, immediately to the north-east. Between the Ténéré and Nigeria the surface sand is now anchored and the general healthy appearance of the plant life and the vigorous growth of young trees argue a well-established and stable vegetation rather than one which is doomed shortly to disappear.

During the tornado season (May and June) occasional strong winds displace the surface sand on many areas of open farmland, burying the young crops and necessitating repeated sowings. As many as ten sowings have had to be made in exceptional years. The displacement is particularly noticeable in the Dallol Bosso, where in some localities the sand is banked against walls and hedges. Many appear to regard this process as evidence that the country is becoming drier. The displacement is purely local however, and it occurs only where the cleaning of the land has been so thorough that there is practically no vegetation on the soil during the sowing period. The Commission was struck by the fact that on normal farms and in the bush there was seldom any sign of sand drift or of any banking of sand against hedges which had been in existence for twenty years or more. On the Agricultural Department's demonstration farm near Daura evidence of sand displacement could be seen, while on an adjoining native farm, which had not been so thoroughly weeded, the sand was fixed. As a general rule, even on clean farms, it is only in areas of very light soil and in years when the rains are exceptionally late that any

great inconvenience is caused to the farmers. There is no evidence that sand displacement by tornadoes is increasing, except perhaps in localities where the increase may be attributed to an expansion of farming. The Dallol Bosso is the most densely populated portion of Niger Colony, and in some localities the vegetation has been almost completely stripped off over considerable distances. It is precisely in these localities that the local displacement of sand is most evident.

For several months during the dry season the general wind direction in the western Sudan is from north-east to south-west. This wind, known as the *harmattan*, carries fine material in suspension which is sometimes dense enough to reduce visibility to 50 yards and to interfere with the air-mail service. This fine material is deposited when the wind drops and is incorporated with the soil.[1] Professor Stebbing seems to fear that it is reducing the fertility of the farmlands. The soils of the northern districts of Nigeria are however very light in texture, the coarse sand and fine sand fractions forming usually nearly 90 per cent. of the bulk. They are typical of the soils over a large proportion of the western Sudan. The pH value is about 5·8 and the content of exchangeable bases in the lightest soils about 2 milligram-equivalents per cent. The addition of harmattan dust therefore, so far from being harmful, improves the quality of the soil both mechanically and chemically. There is in fact a native tradition that a good harmattan means a good harvest.

The retrogression of the vegetation.—The greater part of the northern provinces of Nigeria is covered with orchard bush with a grassy undergrowth. Near the northern boundary the forest consists largely of thorn species, principally acacias. The thorn forest continues into Niger Colony, where it is separated from the dunes of the Ténéré by a strip of country about 15 miles

[1] The amount of dust deposited annually by the harmattan has not been ascertained; the quantity is so small that it would be difficult to measure. Mr. H. C. Doyne of the Nigerian Agricultural Department has examined a representative sample and found that it had the following mechanical analysis:

	per cent.
Coarse sand (2·00–0·200 mm.)	0·0
Fine sand (0·20–0·020 mm.)	10·8
Silt (0·02–0·002 mm.)	24·5
Clay (<0·002 mm.)	64·7

The pH value was 7·1 and the content of exchangeable bases was 199·2 milligram-equivalents per cent., equivalent to 10 per cent. of calcium carbonate. The silt fraction contained a considerable proportion of calcium carbonate. The chemical analysis of a carefully collected sample, carried out by the Imperial Institute, was as follows:

	per cent.
Silica	49·34
Alumina	10·34
Titanium oxide	0·66
Ferric oxide	4·14
Lime	5·28
Magnesia	2·07
Potash	1·62
Soda	0·80
Loss on ignition	24·81
	99·06

wide in which grass is almost the sole vegetation. Professor Stebbing affirms that the forest formations of northern Nigeria are becoming more and more open with the drying up of the water supplies and that they are in process of degeneration into grassland. He does not produce any satisfactory evidence to support this disturbing statement. The disappearance of forest is not necessarily a sign of degeneration. Professor Stebbing refers for instance to the desert-like aspect of Geidam, and it is true that the town is now surrounded by land almost bare of trees whereas twenty years ago it was encircled by forest. During the dry season, after the crops have been reaped, the bare sandy plain looks like a typical piece of desert. What appears however to be barren ground is actually fertile farm land and during the rains it yields an abundant harvest of useful crops. The District Head of Geidam has farmed land outside the town for twenty-three years without a single fallow, and he states that his corn crops are "as high as a house." The replacement of bush by farmlands, where these are permanent, is surely a sign of progress. It is a process which has taken place in all civilized countries.

The Commission came to the conclusion that as far as it was possible to judge within the limited time available, the present forest formations are not being threatened by changing climate or by a sinking water-table. Their future continuance is being threatened only by indiscriminate felling and burning by farmers and shepherds, and by erosion. These influences are discussed later. Natural regeneration of the forest is in general satisfactory and is often so abundant as to give the impression that the forest cover in some localities is becoming denser. In Bornu the grasslands bordering Lake Chad are dotted with young *Acacia tortilis*, suggesting that trees are beginning to establish themselves in an area formerly covered almost exclusively by grass and the shrub *Calotropis procera*. Similarly, the grassy Manga country appears to be in process of colonization by *Acacia* (*Faidherbia*) *albida*. According to native information several areas in Niger Colony are much better wooded to-day than they used to be. This information has been confirmed in some cases by the observations of French officers within the last twenty years. The improvement cannot be attributed entirely to re-growth following the cessation of farming since it is found in some districts which have not been farmed, if at all, for at least a hundred years. Of recent years the French administration has adopted measures designed to control or prevent the destruction of trees by lopping and burning, and the expansion of woodland around Agadès and other towns may be due partly to the restrictions imposed. However the new forest growth in localities remote from centres of population and from trade and cattle routes cannot be explained in this way.

In some marshy depressions along the Komadugu Yobe and around several *tabkuna* in Niger Colony there are groups of dead or dying trees. Photographs of such groups are often brought forward as evidence of desiccation but, as several writers have pointed out, the death of the trees is due not to a lack of water but to a superabundance of it. In Chevalier's view the trees have been killed by asphyxiation following the continued deposition of clay at the bottom of the pools.[1] Sandford suggests that water-logging or the

[1] A. Chevalier, 'Les productions végétales du Sahara,' 1932.

salinity of the water is responsible.[1] In some cases trees may be standing in water and yet be dying from a deficiency of moisture. This apparent anomaly is the outcome of the manner in which *tabkuna* are formed and tend to get filled. Clay accumulates by alluviation around the roots of the trees and eventually forms an impervious layer on the surface. The manner in which corn is stored in Dikwa Emirate in dry sand below a clayey surface subject to flooding illustrates how efficiently clay can seal off moisture. Since *tabkuna* are floored with tenacious clay which becomes indurated when it is exposed in the dry season it is not surprising that there is often little regeneration of the trees which fringe them. The death of trees through an excess of water is particularly striking when the trees involved are ones which prefer relatively well-drained conditions. Instances of this are not lacking. Near the road between Kazaure and Damberta, for instance, there is a group of dead *Parkia filicoidea* about eighty years old which in January 1937 was standing in 2 feet of water. The trees were not killed by the exceptional rains and flooding of 1936 for they appear to have been dead for about five years.

Amongst the thorn forest in Niger Colony trees such as *Daniella oliveri*, *Celtis integrifolia*, *Khaya senegalensis* and *Anogeissus Schimperi* are occasionally met with, which are somewhat north of their normal habitat. The regeneration of these trees is usually deficient. They occur principally in depressions, where moisture conditions are most favourable. Aubréville looks upon these trees as relics of a moister vegetation which occupied the western Sudan during the early Quaternary humid period.[2] He believes that when arid conditions supervened the original vegetation was able to survive only along streams and in moist depressions, and that it has maintained itself with difficulty ever since. In view of the fact that since the Quaternary pluvial period there has been at least one period during which desiccation was so severe as to permit the formation of sand dunes in the regions now covered by thorn forest, it seems more probable that the trees established themselves in a more recent humid cycle. As will be shown later, there are good grounds for believing that the rainfall is cyclic in character, *i.e.* series of years of good rainfall alternate with series of years of deficient rainfall. Sandford has demonstrated the remarkable advance of plants and molluscs into arid areas after a few years of good rains and the persistence of the invaders long after conditions have deteriorated.[3] A long cycle of wet years would bring about a marked improvement in the appearance of the country along the desert border and would be quite sufficient to account for the occurrence of the moister type of trees in their present situations.

The tamarind (*Tamarindus indica*) is common along the Komadugu Yobe and in other well-watered localities. In well-drained sandy areas in Niger Colony and the northern front of Nigeria it is rare, except where it is associated with the baobab (*Adansonia digitata*). The association of these two trees, first noted by Barth,[4] is particularly common between Gumel and Nguru,

[1] K. S. Sandford, "Sources of water in the N.W. Sudan," *Geogr. J.* 85 (1935) 422.

[2] *Loc. cit.*, pp. 29, 30.

[3] K. S. Sandford, "Observations on the distribution of land and freshwater mollusca in the southern Libyan desert," *Quar. Journ. Geol. Soc.*, vol. mcii, part 2, 1936.

[4] H. Barth, 'Travels and discoveries in north and central Africa,' vol. 2, 1857, p. 91.

Parkia killed by flooding at Kazaure

The river Rima near Sabon Birni

Successive stages in the association of tamarind and baobab, ending in the destruction of the latter

the

where in places almost every baobab has a tamarind growing alongside it. The tamarind seeds are brought by the animals who seek the shade of the baobab, and they are enabled to germinate and take root because the shade retards the evaporation of the soil mixture. Once the tamarind has become firmly established it grows to full height and often thrusts aside and overturns the baobab.

Erosion is responsible for the death of many trees. The process is especially marked in the Kadzel and in the adjoining portion of Bornu, *i.e.* on both sides of the Komadugu in the neighbourhood of Lake Chad. Here the land is littered with dead trees which have toppled over as a result of the denudation of the soil around their roots. The eroded material is being deposited on wide flat plains which are flooded each wet season and on which the establishment of new tree growth is well-nigh impossible. It is probable that when the plains have become silted up the water will drain away to the Komadugu and colonization by plants will commence. The erosion in this area is very rapid. The change of conditions which caused it is not easy to determine, but no doubt the clearing of the bush during farming operations has assisted the process.

Erosion is active in the neighbourhood of streams and in upland country, but a large proportion of northern Nigeria and Niger Colony consists of wide sandy plains and in these erosion does not appear to be an important factor. In some hilly areas erosion is actually playing a beneficent part. Extensive flat-topped hills of sedimentary rock are common in both northern Nigeria and Niger Colony. They are capped with an indurated layer of ironstone on which there is often little or no soil, so that farming is impossible. Erosion is slowly eating away these hills and will eventually convert them into useful land. There are barren hills of this type in both eastern and western Tangaza (Sokoto Province) and it is obvious that they are the relics of what was once a continuous plateau. Erosion and weathering have converted the central part of Tangaza into good land which yields heavy crops. The latest stages of the process may be observed near Kano, where hills have been worn away into rounded slopes on which grass has established itself. Soil is beginning to form and in due course the slopes will be come cultivable. It is perhaps necessary to be a geologist to take so long a view.

In the western Sudan shifting cultivation is the usual farming system. A patch of bush is felled and burnt and crops are grown until the yield begins to decrease. A movement is then made to a neighbouring patch of bush and the process is repeated. The period for which the land is left fallow varies greatly, being longest in sparsely inhabited areas where there is plenty of bush land. Before the European occupation the people were compelled to live in settlements or within easy reach of a town in which they could take refuge during raids by neighbouring tribes. The pacification of the country has safeguarded life and property, and consequently in the last twenty years shifting cultivation has expanded to a remarkable extent. The present rate of destruction of forest in Nigeria by shifting cultivation has been estimated at 1000 square miles a year.[1] There is no doubt that the practice is altering

[1] R. M. Gorrie, 'The use and misuse of land,' Oxford Forestry Memoirs, No. 19, 1935, p. 61.

the sylvan conditions of the western Sudan. The most striking example of this seen by the Anglo-French Forestry Commission was near Magaria, where in a portion of a fine forest of *Prosopis Africana* all the trees were dead. It was found that every dead tree had been ringed or burnt to clear the ground for farming.

In arid regions the continual felling of the bush may lead to so great a deterioration in the fertility of the soil that the original forest formations are eventually unable to re-establish themselves even when forest protection is introduced, and their place is taken by vegetation of a lower order.[1] Professor Stebbing believes that ecological retrogression and soil deterioration have already reached a serious stage in West Africa. The soil deteriorates through the truncation of the profile by erosion, through the loss of humus, and through the reduction of the soil moisture. Over the greater part of the northern districts of Nigeria and in Niger Colony the soils are sandy and the surface relief gentle. The run-off during the rains is therefore low. It is only around hills and near drainage channels that soil erosion is active and bad lands being produced. As far as one may judge from crop yields, no permanent damage has yet been done to the soils over the greater part of the region. In spite of the most careful inquiries not a single instance was found by the Commission of land being permanently abandoned because it had lost its fertility. Around Godabawa and Birnin Konni, areas which have been intensively cultivated for several generations, crops were said to be poorer than formerly but everywhere else the yields were reported to be as good as, if not better than, they ever were. The deterioration of the soil around Godabawa and Birnin Konni is the result of the local practice of fixed farming, unaccompanied by adequate manuring. Land in any part of the world will fall off in quality if crops are continually raised on it and if nothing is returned to the soil. Fixed farming can be practised successfully only if the soil is treated fairly regularly with fertilizers or manure. As regards the retrogression of the vegetation it is often remarked by foresters in Nigeria that it is well-nigh impossible to tell whether a patch of bush is an old fallow or part of the original cover. The growth on land which has been fallow for forty years resembles closely bush which, as far as native tradition goes, has never been felled. Often the only indication of former cultivation is the presence in the bush of such trees as *Adansonia* and *Parkia* which are usually protected around towns.

It may therefore be said that soil conditions in northern Nigeria and Niger Colony have not yet in general deteriorated so far as to threaten the continuance of the forest formations. Unless the practice of shifting cultivation is regulated however there is no doubt that the cultivable areas in the western Sudan will eventually become a country of temporary farmlands and scrub fallow. The longer restrictions are delayed the more difficult it will become for the forest to re-establish itself, since the number of trees remaining to carry on regeneration is becoming progressively less. Every effort should be made to encourage the agricultural communities to adopt the practice of fixed cultivation wherever this is practicable. What can be achieved in this direction is demonstrated by the beautiful park-like country around Kano

[1] L. Lavauden, "The equatorial forest of Africa: its past, present and future," Imperial Forestry Institute, 1935.

where the farms are permanent and regularly manured and are studded with useful trees such as *Parkia, Faidherbia, Prosopis* and *Tamarindus.*

Herdsmen cause the death of many trees by pollarding them to provide fodder, and they also interfere with regeneration by their practice of burning off the long grass. In well-stocked areas the animals further hinder regeneration by eating the young shoots as soon as they appear. The damage done in this way is most noticeable in the arid regions north of the limit of cultivation, where the bush is most open and its regeneration least assured. There is no reason to believe however that flocks and herds form a serious menace to the continuance of the forest, and in no area visited by the Commission had overgrazing gone so far as to induce erosion. It is of interest to note an instance in which the presence of stock has actually caused an extension of the forest vegetation. The country around Abalama, between Aderbissinat and Agadès, was bare of vegetation in 1920, when a well was constructed by the Service des Puits. Around the well there is now a healthy young forest of *Acacia seyal.* This forest owes its existence to the cattle, sheep, and goats, which are watered at the well daily. The germination of the seeds is assisted by intestinal fermentation and the growth of the plants is promoted by the droppings of the stock. The surprising number of young plants which occur along the sandy cattle track between Agadès and Tessaoua originate in the same way.

The reduction of rainfall.—It was the meteorological records of the Senegal which led Hubert to assert that the rainfall was decreasing. The annual rainfall of the western Sudan fluctuates widely on each side of the mean value, and a very extended series of observations would therefore be necessary before a progression towards increased or decreased precipitation could be established. Reliable meteorological records in West Africa do not go back much farther than the beginning of this century and any conclusions based upon them are valueless. Bruckner made a careful study of records of rainfall in Europe, of variations in lake levels, and of the advance and retreat of glaciers, and he came to the conclusion that a distinct periodicity of about the same number of years exists with respect to temperature and rainfall. A series of somewhat cooler and more rainy years is followed by a series of rather drier and warmer years. The interval at which the sequence is repeated varies from twenty to fifty years, with an average of about thirty-five years. Chudeau believed that the rainfall of West Africa varies in cycles according to Bruckner's Law, basing this opinion on an investigation of the rainfall records at French West African stations and of the writings of the early explorers.[1] Tilho made a detailed study of the variations of Lake Chad and concluded that these also are cyclic in character, following the rhythm of the Alpine glaciers.[2] He made the interesting forecast that Lake Chad will be very low about 1940–50 and very high about 1952–57.

In regions with a low mean rainfall such as much of the western Sudan, a series of relatively dry years would have a particularly marked effect, causing a reduction in the amount of surface water and the death of much vegetation.

[1] Chudeau, "Le problème du desséchement en Afrique occidentale," *Bull. Com. A.O.F.* 1921.

[2] J. Tilho, "Variations et disparation possible du Tchad," *Ann. de Géographie,* No. 207, 1928, pp. 238–60.

It was Chudeau's contention that most of the facts advanced by Hubert in 1920 as recent evidence in favour of his theory of progressive desiccation were due to a dry cycle. Writing in 1921, Chudeau expressed the opinion that West Africa had just passed through a dry cycle with a tendency to amelioration in the last years.[1] As far as the northern provinces of Nigeria are concerned, rainfall records are available only since about 1916, but there is reason to believe that the first fifteen years of this century were, on the whole, ones of deficient rainfall. There was a serious famine in 1913, and about 1916 the apparent evidence of desiccation caused great concern. Many streams and pools had dried up and the Resident of Sokoto stated that owing to the failure of the water supplies it might become necessary within five years to abandon the Government station.[2] The submerged surface of Lake Chad was reduced in 1908 and again in 1914 to less than 4000 square miles, about half its normal area. None of the gloomy predictions has yet been fulfilled, and the good rains of recent years have greatly reduced the number of those who consider that desiccation is taking place.

During its tour of northern Nigeria and Niger Colony the Anglo-French Forestry Commission obtained evidence which seems to indicate that the amount of surface water in this area is at the moment on the increase. In January 1937 the waters of Lake Chad were within one mile of Nguigmi. It was stated by the Commandant of the post and by the native chief of the district that this was the highest point reached by the lake this century. In Katsina Emirate water has returned to a drainage channel at Matsai which had been dry for sixty years. Near Tsiga in the same emirate water appeared in a dry stream bed a few years ago and has ever since persisted in the form of a series of disconnected pools well into the dry season. In Daura Emirate the wet season water in a channel running northwards near Rijiar Mata has been increasing for some years and the annual flow is reaching a point farther north each year. The unsatisfactory nature of the water supply at Kazaure was a cause of some hardship to the people about fifty years ago. During the dry seasons water had to be obtained from pits sunk to a depth of 8 feet in the bed of the stream outside the town. The level of the water has risen, markedly so in recent years, and water can now be obtained even at the end of the dry season within a few feet of the surface of the stream bed. Two miles southwest of Kazaure there is a large perennial lake known as Wawan Rafi. The extent of this lake has been increasing for some years. The waters have already destroyed a road and overwhelmed some farmlands. At Tsaba in Kano Emirate a completely new body of water has appeared during the last few wet seasons. During the rains the water meanders over farmlands and seems to be in process of carving a channel for itself. In 1932 and again in 1936 the water in the Komadugu Gana reached the Komadugu Yobe beyond Geidam These two streams had not previously met this century.

These instances of increasing surface water cannot be regarded as demonstrating a change of climate towards greater humidity any more than an equivalent decrease of surface water in dry years could be regarded as proof of

[1] *Loc. cit.*, p. 360.

[2] E. W. Bovill, "The encroachment of the Sahara on the Sudan," *J. Afr. Soc., Lond.* 20 (1921) 183.

progressive desiccation. However they lend support to the suggestion of Chudeau that in 1921 West Africa had entered a cycle of wet years. Further support for Chudeau's opinion is afforded by the abundant regeneration of the vegetation, by the expansion of woodland in some areas, and by the colonization of grassland by young trees. The present wet cycle may be said to have commenced about 1917 and, if the periodic interval conforms to the average of thirty-five years according to Bruckner's Law, the next wet cycle should arrive about 1952. This accords well with Tilho's forecast of a very high Chad about 1952–57. The periodic interval varies so widely however that no reliance can be placed in this calculation. What can be stated with confidence is that when the next dry cycle arrives there will be no lack of prophets to predict the doom of the West African colonies.

The lowering of the water-table.—It has often been asserted that the water-table in the western Sudan is sinking, that wells are drying up, and that in consequence districts have been deserted which were formerly centres of a considerable population. Since 1929 the Geological Survey of Nigeria has been principally responsible for water-supply development in the north of the Protectorate. By the end of May 1937 the Survey had constructed 1003 concrete-lined wells, with a total footage of 110,000 feet. Well-sinking operations were preceded in each area by a geological survey in the course of which native shafts were measured and careful inquiries made regarding the fluctuations of the water-table. In this way a great deal of information has been collected by the Survey regarding the behaviour of the groundwater in the northern provinces of Nigeria, and this information has been supplemented by the experience gained by the officers of the department during the course of shaft construction. On questions relating to subsurface water in Nigeria, therefore, the Geological Survey speaks with authority, and it is the opinion of the Survey that the water-table is to all intents and purposes stationary. If the water-table is sinking the process must be so slow that the habitability of the country will not be impaired for many centuries to come.

Many native shafts have ceased to yield water, but this is a consequence of the primitive methods of construction. Where native wells have any lining at all, the lining consists of saplings and roots wound into a spiral or of logs laid at right angles to form a square. Neither type of lining can withstand great pressure or adequately prevent the entry into the shafts of loose sand from the strata. Where the aquifer is unconsolidated, native shafts cannot be carried more than a couple of feet into the water. In the dry season, when many surface pools have dried up, the wells are overdrawn and sand rises in the bottom. Ropes and calabashes and debris from around the mouth of the wells also reduce the yield of water. Many wells have to be cleaned out each dry season, and to a casual observer it appears that they are being progressively deepened. The process leads to cavitation at water-level and sooner or later the linings fail, the walls collapse, and the wells are abandoned. Many of the native wells in northern Nigeria and Niger Colony were sunk by slaves. Now that slave labour is no longer available the collapse of a well is often followed by the migration of the local people, who prefer to leave for a locality where there is a producing well or surface water rather than to undertake themselves the arduous task of shaft construction. Local movements of

population caused in this way are particularly common in Bornu and eastern Kano, where loose sand in the strata greatly adds to the difficulty of constructing well shafts by native methods.

It often happens that a deep shaft passes through one or more water-bearing horizons before reaching the true water-table. At Sokoto, for instance, there are two such "perched aquifers." Perched aquifers owe their existence to impervious beds in the strata. They are known throughout the world and are not, as Professor Stebbing appears to suppose,[1] a sign of a successive lowering of the water-table. In the western Sudan some small perched aquifers are fed by water from shallow drainage channels. In cases where the passage of water from the upper reaches of the channel is obstructed by sand accumulated during a former period of aridity or by the deposition of silt, the extent of the perched aquifer tends to decrease and the wells tapping it to fail. Such cases are examples of the gradual depletion of "fossil" water and not of contemporary desiccation. The interruption of the drainage lines has sometimes the effect of impounding water and, where the sequence and disposition of the strata are suitable, of bringing about the formation of a perched aquifer where there was none before. Perched aquifers formed in this way are generally fairly stable, the amount of water introduced into the aquifer during the rains being roughly balanced by the amount withdrawn from wells and evaporated from the water in the channel. The best known example in Nigeria of this type of perched aquifer is due to an obstructed channel which can be traced from Murguba to Magumeri in Bornu Province and which formerly conducted drainage towards Lake Chad. Around Magumeri, at what is now the lower end of the channel, there is extensive flooding each wet season. The water finds its way into an arenaceous stratum amongst the predominantly clayey sediments of the district and feeds an aquifer which lies 100 feet above the true water-table. There is an example in Daura Emirate of the formation of a perched aquifer in recent years. Around Rogogo the old deep wells are being destroyed by the entry of water into the shafts at a level of about 100 feet above the water-table. Recently constructed shafts obtain a satisfactory supply of water from the new perched aquifer. The area affected is traversed by an obstructed drainage channel.

The shrinkage of streams and lakes.—It has been pointed out that many of the examples of reduction of surface water which caused so much concern in West Africa about twenty years ago were the results of a sequence of years of deficient rainfall. Since the distribution of surface water is affected so widely by merely temporary variations in the precipitation, one cannot base any conclusions regarding the progress of desiccation on alterations of lake levels or of stream flow which have been observed in the course of the last generation or two. If however we go farther into the past and accept historical and archaeological evidence, there appear to be grounds for believing that many of the larger lakes in the western Sudan are slowly decreasing in size. It seems to have been established, for instance, that an arm of the Niger, now dry, conducted water into the country north of Timbuktu as recently as the thirteenth century.[2] It is often stated that the present Lake Chad is a

[1] Stebbing, "The threat of the Sahara," *J. Afr. Soc., Lond.* May 1937, p. 9.
[2] Gautier, 'L'Afrique noire occidentale,' p. 39.

Trees, chiefly Parkia, in the Kano farmlands

Faidherbia in the farmlands near Zinder

Mutilation of trees by graziers, near Garki (Kano)

An anchored dune near Garanguna

shrunken relic of a much greater body of water and that the shrinkage has been caused by desiccation. This view appears to be based on a merely superficial knowledge of this part of Central Africa. It is true that the Chad basin formerly contained a vast inland sea, but there are no grounds for concluding that there was any continuity between this sea and the present lake.[1] The old basin became partly or completely infilled with sediments (now known as the Chad Group[2]) and was then subjected to gentle earth movements leading to the depression of the Bodeli region, north-west of the present lake. The land was then drained by streams running eastward across the present site of Chad. The Bahr-el-Ghazal, a depression running north-eastwards from the south-east corner of Lake Chad, is a portion of a drainage line dating from this period. The next event was severe desiccation. French observers who have examined the islands in Lake Chad regard them as old sand dunes, so that desiccation must have reached an advanced stage.[3] This period of desiccation may have been that during which dunes were formed in the thorn forest belt. During this period the Bahr-el-Ghazal was blocked by sand, and this interruption of the drainage led to the formation of Lake Chad when humid conditions returned.

Although Lake Chad is not a shrunken relic of the sea which at one time occupied the Chad basin, there are grounds for believing that the lake is slowly decreasing in size. Maps of Africa drawn in the seventeenth century show a body of water north of Chad, and the shape of the lake on the old maps seems to indicate that the waters covered a greater area at that time than they do to-day.[4] On the seventeenth-century maps the lake is much reduced in extent. It is doubtful if any reliance can be placed in the work of these old cartographers since the position of the lake on the edge of the world's greatest desert would exaggerate its importance. Moreover in speculative geography the known has always tended to be expanded so as to reduce the limits of the unknown. The seventeenth-century maps of Africa contained less vacant space than did those of a hundred years later. However, even if this historical evidence of a decrease in the size of Chad is disregarded, one would be led from a study of the physiography of the region to conclude that many of the lakes in the western Sudan are shrinking. The agencies principally responsible for the process are: the interruption of the former drainage lines during a regional desiccation, the silting up of streams, and river capture.

One may conclude that the amount of surface water carried in the direction of the Sahara is being reduced by these agencies. Unless the northward-flowing streams become rejuvenated by an earth movement the process must lead in the distant future to the disappearance of surface water in the arid region bordering the desert, except that fed by the direct rainfall. It is possible that the shrinkage of surface water will cause a slight lowering of the water-table, but if it does so the agricultural crops and the normal bush of the region will not necessarily be affected. Over a large proportion of northern Nigeria

[1] Falconer, 'The geology and geography of northern Nigeria,' p. 217.

[2] Raeburn and Brynmor Jones, "The Chad basin: geology and water supply," *Bull.* No. 15, Geol. Survey of Nigeria, 1934.

[3] G. Garde, 'Entre le Niger et le Tchad,' 1911.

[4] Tilho, *loc. cit.*, p. 244.

and Niger Colony the water-table lies from 50 to over 300 feet below the surface. It is obvious therefore that the normal vegetation receives its nutriment not from the water-table but from the soil water, which is annually replenished by the direct rainfall.

The migration of the population.—Abandoned towns, and towns which contain a smaller population than formerly, are known in many parts of the western Sudan. Migrations of population may be brought about by a variety of causes, but those which have occurred in the arid regions around the Sahara are usually ascribed unhesitatingly to progressing desiccation. It is true that the habitability of some localities has been impaired by drainage changes even during the historical period, but there is no doubt that the main population movements have been caused by political and economic factors. Up to the close of the last century the principal trade routes of the western Sudan ran northwards across the Sahara towards the Mediterranean sea-board. Along these routes there were important towns, associated chiefly with the native salt trade and the traffic slaves. Following the European conquest the slave trade was suppressed and the trade in native salt declined owing to the importation of salt from Europe. As a natural consequence many of the desert towns have been partially or completely abandoned. The drift of population outwards from the desert has been hastened by the increasing prosperity of the people in the regions of better rainfall. The principal export of West Africa to-day is agricultural produce, and the channels of trade are not the old trans-Saharan routes but the roads and railways running down to the coast.

M. Loppinot, an administrative officer in Niger Colony, informed Professor Stebbing that in the country north of Tahoua the desert was advancing at the rate of 1 kilometre a year.[1] This estimate appears to have been based on the fact that land stretching to 250 kilometres north of Tahoua which was under cultivation in places two centuries ago is now uninhabited except by nomads. Within the boundaries of Nigeria also there are vast tracts of country, particularly in Bornu and Kontagora, which formerly contained a considerable population and which at the time of the British occupation were almost uninhabited. As far as these Nigerian areas are concerned it is known quite definitely that the depopulation was not due to deterioration of soil or of climate but to intertribal wars, slave-raiding, and pestilence. Since the pacification of the country by the British, gradual re-settlement has been taking place. There is no doubt that the southward movement of the people who were formerly settled in the country north of Tahoua was caused in the same way. These people were negro cultivators of the soil and the areas which they formerly inhabited are now occupied for the most part by Tuareg, who are a pastoral, not an agricultural, race. It has been shown that the Tuareg came to the Sahara in three successive waves, the latest of which arrived in the latter half of the seventeenth century.[2] These invaders were equipped with camels, which had been introduced into the Sahara at the close of the Roman Empire, and they were therefore able to make sudden long-range raids on the negro settlers in their quest for booty. The negroes were no match

[1] Stebbing, 'The encroaching Sahara,' p. 515.

[2] Rodd, 'The people of the veil,' 1926.

for the warlike Tuareg, and they were forced to abandon their farms and migrate to the southern fringe of Niger Colony and to the northern districts of Nigeria, where they were sufficiently strong numerically to withstand the raiding parties. There they had, moreover, a natural ally in the milder climate against any sustained effort of the Tuareg to displace them, since camels, the principal wealth of the Tuareg, are delicate animals and flourish only under very arid conditions. It is said that even at Agadès there is high mortality among the camels from pneumonia and similar diseases during the short wet season. Corn growing has continued without interruption in the Damergou, where the people have always been under the protection of the Tuareg of Aïr.

Since the occupation of Niger Colony by the French, the Tuareg and the negroes have been able to live side by side in peace, if not in friendship, and there is consequently to-day a gradual spreading of the farming community from such places as Zinder, Maradi, and Tahoua towards areas farther north which their ancestors had abandoned. There is no reason to doubt that most of the land in the western Sudan which has been farmed in historic times is still capable of yielding good crops.

Professor Stebbing describes a journey made in the fifteenth century by El Haji Muhammad and a considerable retinue from Goa through Agadès and Bilma to Mecca.[1] He concludes that the mere fact that the journey was successfully completed implies that the country traversed must have been better watered and more fertile than it is to-day. Aubréville has pointed out however that the route followed by Muhammad is still practicable and is still used.[2]

Conclusions

West Africa has experienced several climatic changes since the beginning of the Quaternary period and the last major change appears to have been one towards more humid conditions. It is impossible to say whether the climate is now becoming drier or whether it is becoming moister since, except for minor oscillations characterized by cycles of years of relatively high and of relatively low rainfall, the climate has shown no great alteration during historic times. This is in accordance with the modern view of the stability of climates for long periods of time. Climatic change takes place so slowly that the process cannot be detected in the space of a few hundred years. There is no need therefore to fear that desiccation through climatic causes will impair the habitability of the West African colonies for many generations to come.

The silting up of streams and river capture are reducing the amount of surface water carried into the regions fringing the Sahara. This is a consequence of the configuration of the country and nothing man can do will prevent it. The process may be delayed however, and to some extent controlled, by river conservancy directed towards the protection of the headwaters and to flood control. Desiccation caused in this way is proceeding very slowly, and it does not constitute an immediate threat to the prosperity of the

[1] Stebbing, 'The encroaching Sahara,' p. 514.
[2] *Loc. cit.*, p. 75.

West African colonies. The groundwater, which is the main reservoir of water for the people and their stock, shows no sign of diminishing.

The climatic changes which have taken place in West Africa have been accompanied by very slow expansions and contractions of the Sahara. To-day the nearest of the masses of live desert sand to Nigeria lies 150 miles north of the frontier of the Protectorate. South of these dunes the sand is fixed by vegetation, which appears to be firmly established. The sand is not encroaching on to the farmlands and the West African colonies are not threatened by an advancing Sahara. The establishment of a vast shelter belt of trees is therefore unnecessary. In any case, as far as Nigeria is concerned, a natural barrier already exists in the great thorn forest of Niger Colony. This forest requires no protection against destruction by man since over the greater part of it the rainfall is too low for agriculture to be profitable.

The displacement of sand on some bare farmlands need not cause anxiety. It is a local phenomenon due to unwise farming methods, and it can be dealt with without resort to expensive regional schemes. A mere ground cover of weeds serves to prevent sand displacement, and farmers should be taught not to clean-hoe their farms until the rains have moistened the soil. It should be possible to introduce a ground crop which will fix the soil during the critical period and which at the same time will provide an economic return as fodder or green manure. A reasonable proportion of trees should be allowed to remain on the farms so as to break the force of the wind. The small amount of dust deposited annually by the harmattan does not interfere with cultivation and is probably good for the soil.

Erosion is taking place around streams and in hilly areas. The protection of the forest at danger points would do much to retard the process, and around headwaters especially it is advisable that this action should be taken. Thanks to the general evenness of the topography and to the porous nature of the soil there is no need to fear in the West African colonies the widespread destruction of farmlands such as has occurred in the United States and in China.

The natural forest formations appear to be stable except where they are being interfered with by man. The bush has a healthy appearance and there is vigorous regeneration. The destruction of trees by herdsmen and their stock is not as important a factor as is commonly supposed, but it should be prohibited on fallow land which has been exhausted by farming. Bush burning is not causing serious damage in the more arid regions since the grass is too thin and the bush too open to support really destructive fires.

The widespread practice of shifting cultivation has not yet had serious consequences but it threatens the economic future of the drier portions of the West African colonies. Unless checked it will lead eventually to the disappearance of the original forest cover and to a loss in the fertility of the soil. Wood and other forest products will become scarce, and erosion will be accelerated. Cattle owners will be forced to seek pasturage in areas remote from settlements, and farmers will have difficulty in obtaining manure for their land. The remedy lies in the reservation of a large proportion of the remaining forest and in the encouragement of fixed farming. The forest reserves need not be left idle. Some of them in suitable areas should be

regarded as reserves for pasture, and permanent wells should be provided in them for watering stock. Regulations regarding bush fires would be advisable in some cases.

The most prosperous areas in northern Nigeria and in Niger Colony are those around Kano, Sokoto, and Zinder, where fixed farming is the rule; the Kano farmlands are models in this respect. There the farms are properly demarcated and regularly manured, and they contain numerous trees of economic value. The adoption of fixed farming can be promoted by allotting to the farmer a definite plot of land with well-marked boundaries, by providing an assured water supply, and by encouraging the construction of permanent houses. The area of land assigned to each farmer will, of course, vary with the nature of the soil. In some districts the soil is so sandy that fixed farming would be impossible without very heavy dressings of manure. In such districts shifting cultivation must remain the normal practice, but it should be possible to control its limits.

BRITISH GRAHAM LAND EXPEDITION, 1934–37

J. R. RYMILL

Continuation of a paper from the April Journal. Evening Meeting of the Society, 1 November 1937

Now that we were all back at the base there were three main things to be done before we could start the long journeys: to make the flight round the north end of Alexander I Island; to locate if possible the depot and tractor which we had abandoned on the sea-ice near Terra Firma; and to provide more dog food. Since we had arrived in Marguerite Bay seals had been scarce and the dogs were feeling the lack of fresh meat. Bertram and I found plenty up the northern fjords, and had left a good cache of them on an island about 30 miles away. While Riley and Bertram went off with two teams to collect them, Bingham and Fleming, also with two teams, started south to try to find the depot. While they were away Hampton and I prepared for the flight round Alexander I Island.

The morning of August 15 was clear except for low clouds to the south and south-west. Hampton and I decided to fly, and were in the air by 11.30. The temperature on the ground was −30° F., but as we climbed, owing to inversion which is usual in this part of the world, the temperature rose, and at 2000 feet it had gone up by 20°, thereby clearing the frost off the windows, and we were pleased to see that the visibility was going to be good, for we could just distinguish the northern part of Alexander I Island about 90 miles away, and we headed straight for it. On a flight like this, even when we could just see our objective, we kept a careful check on the course, using a drift-indicator let into the cabin floor.

As we drew level with the mouth of the narrow fjord in the south-west corner of Marguerite Bay which Hampton and Stephenson had seen while flying on March 13, we were surprised to see that it appeared to be a much larger feature than they thought when they had seen it from the turning-point of their flight; then they had been looking at it from a bad angle, which gave it the appearance of being much narrower than it really was. Although we could now see that it was a major feature of some kind, we were not very much better off than they, for the cloud which had been hanging about all the morning was still heavy in the south. As it was gradually clearing we hoped for a better view on the way home.

When we were about 20 miles off the Alexander I Island coast, we were worried to see that the ice beneath us was becoming thin, and looked as if it had recently been broken up. A few miles farther on we began flying over open cracks and pools, while everywhere the ice looked a dull, grey colour, and was broken into pans 100 to 300 yards across. These in many places were separated by open water or patches of ice so thin that they were only a little lighter in colour than the dark open pools themselves, while 15 to 20 miles out at sea a low, heavy fog-bank indicated the northern limit of the pack.

We followed the north coast of Alexander I Island eastward, gradually gaining height until we were flying at about 6000 feet, and eventually sighted

what appeared to be Rothschild Island, which we found to be part of the mainland. For the whole distance round the coast the sea-ice was very thin and broken up by leads and pools, while out to sea the low fog continued in east–west direction. Along the coast the ice-cap finished in a high cliff with a broken edge, showing many icebergs in the making. Behind the cliff the ice-cap rose steeply in crevassed slopes to a height of about 3500 feet where the exposed mountains began. These were in great massive groups, intersected by slightly crevassed glaciers, rising gradually towards the interior.

When we had flown for 140 miles we turned for home. We had photographed all the coast on the outward flight, and there was not much for the observer to do on the way back until we were clear of the land and could get a look to the south, which we hoped would now be free of cloud. As we passed the last mountain we eagerly looked towards the large fjord. The clouds had now cleared away and we could see what appeared to us to be a great channel running away to the south for as far as we could see. As its mouth must have been about 60 miles away, we could not make out whether it was filled with sea-ice or low shelf-ice and, unfortunately, we had not enough petrol left to allow us to go and look. We took the necessary bearings for fixing its position roughly on the map and then continued on our way home. After landing we soon had the plane in the hangar and Stephenson started plotting our new discovery on the chart. It appeared when plotted to run in a direction slightly east of south, and to be somewhere about 15 miles wide at its mouth.

This discovery, together with the bad ice off Alexander I Island, upset all our sledging plans, for finding impossible ice, though not unexpected, had completely stopped any idea of sledging to the western end of the Dependencies by this route; but, on the other hand, the new channel had opened up new possibilities. We had of course no idea where it went. It might connect with the Weddell Sea, for, as I have already said, we had been told that Ellsworth had confirmed the existence of Stefansson Strait; or it might be the entrance of a strait leading to the west somewhere behind Alexander I Island. By this time, judging from our own experiences in the air, and from what we had already discovered to be wrong in previous reports, we were naturally very sceptical of information brought back from hurried single flights without any kind of ground control. Even so, it was extremely difficult to disregard totally the reports of two well-known airmen like Sir Hubert Wilkins and Mr. Lincoln Ellsworth when drawing our own conclusions. It was obvious that we should have to make a reconnoitring flight down the channel before we could form any plans for the future.

But in the meantime Bingham and Fleming were still away looking for our depot. They had been held up on Terra Firma Island by deep snow and bad weather, and were by now running short of dog food, and on August 22 Hampton and I flew down to them with fresh supplies. It must have been very tantalizing for them to have us land beside them and, after talking for a few minutes, fly back to the base for tea while they plodded on through the deep snow, not to return for some days.

On August 16 Hampton and Stephenson attempted a flight down the new channel, but they flew into low cloud and were forced to return. After

this we had bad weather without a flying-day for eighteen days. Naturally we had everything ready for sledging and were impatient to start, but could not get away until the aeroplane had shown us where to go. At this time the aeroplane had an endurance of three and a half hours, representing a range of 280 miles. On September 4 they at last got away. As the mouth of the channel was about 100 miles from the base, they could fly down it for about 40 miles. As far as they could tell from the air the channel appeared to be about 10 miles wide, in places narrowing down to 5 miles. On the west side there was a solid wall of mountains 8000 feet high. To the east however it was more open, and once they had passed the main headland at the entrance, the country was ice-covered and rising gently to a height of about 5000 feet. In places there were steep valleys down which much-crevassed glaciers flowed, and here and there bare rock ranges pushed out from the high hinterland to form prominent, black-looking capes. Just off the headland, as they entered the channel, there were large cracks in the sea-ice, some of them extending right across the channel, while close in to the shore there were very large pools of open water, and it was obviously impossible to sledge into the channel that way. Immediately south of the headland however the sea-ice finished and the shelf-ice took its place. For the first 30 miles this shelf-ice was badly broken up by glaciers pushing into it and by large bergs breaking off from its free end, but by the time the fliers reached their turning-point the shelf-ice looked absolutely flat and solid. To the south of this point the high western mountains continued but appeared to turn west at a cape about 20 miles farther on. They could see nothing beyond this cape and assumed it was the end of Alexander I Island. On the east or Graham Land side of the strait the coast continued to the south for as far as they could see, finally disappearing in the mist. They had reached latitude 70° 10′ S., but there was no indication at all of any strait coming through from the east side of Graham Land. Casey Channel was marked as being in latitude 69° 30′, but it certainly was not there. There was always a possibility that there was a channel to the south beyond the last point which they could see, but to settle this question we should have to wait for the sledge journey.

On the way back they found a possible sledging-route through the mountains avoiding the open water at the mouth of the strait. This route led from the shelf-ice just south of Cape Berteaux over a pass in the mountains 3000 feet high, and then down on to the channel itself. Finding a way on to the shelf-ice would not be easy, for it was broken by great rifts running parallel to its edge; but Stephenson and Hampton saw what they thought would be a possible way through, if Stephenson could ever recognize it from the ground.

After this flight we were able to form a plan for our forthcoming journeys. We would have two parties: Stephenson, Fleming, and Bertram with three teams would make up one, while Bingham and I with our two teams would make up another. We would travel together over the pass and down into the strait. Then Bingham and I would turn to the west behind what Hampton and Stephenson thought was the south end of Alexander I Island, while Stephenson's party continued south along the Graham Land coast, and if they found Stefansson Strait would turn east through it.

We started on September 5, the day after the flight. Our course took us

Building the southern base on Barry Island

The southern base in August 1936

Towing the aeroplane into Barry Island after a flight

Removing the wheels after launching the aeroplane

past Terra Firma Island to the edge of the shelf-ice just south of Cape Berteaux, and up to this point we had an uneventful time. Uneventful as it was, nevertheless we had bad periods owing to the rough surface which was deceptively levelled off by the winter snowfall; in fact we were forced to relay our heavy loads through the worst places. Soon after midday on the seventh day we reached the edge of the shelf-ice about 60 miles from the base. Most of this time we had been unable to see land owing to low cloud and mist, and we had travelled almost entirely on a compass course. But this day happened to be clear and, on arriving at the shelf-ice, we climbed up to see if we had come to the place which appeared from the air to be most free from crevasses. The cliffs of the shelf-ice were here only about 18 to 20 feet high, and in places so drifted up that they could quite easily be climbed. On this occasion we found that on the first ascent we had climbed on to the top of a large iceberg which had broken away from the shelf-ice, but from the top of the berg Stephenson was able to recognize the right way up. We returned to camp hopeful of getting well in on the barrier the next day, but it was not until the ninth day after our arrival that we were able to travel again, for we had a long period of high wind, snow, and even rain.

On September 20 we were at last able to travel again and succeeded in doing 10½ miles, getting past the worst crevasses. The next day it was snowing and blowing as hard as ever. Lack of visibility was holding us up badly at this stage, as we did not know the nature of the country in which we were travelling. At any moment we might be confronted by one of the many rifts or crevasses which seemed to be scattered haphazard through the shelf-ice. So far we had been away from the base for seventeen days, on eight of which we had travelled. We had done only 71 miles, with a daily average of 4·2 miles. This was not good enough, and I decided to adopt a plan which I had considered during our long stay at the last camp. Up to this time we had still hoped to make the journey across Graham Land to the east, which would require getting back from our two present journeys within about 5½ weeks. Now I decided to cancel this summer journey, giving us longer for the present one. With this in mind I arranged that Bingham and I should reinforce Stephenson's party and eventually leave them with food and other gear so that they could carry on with a full eight weeks' rations, while we returned to the base for fresh supplies. We decided to make the change when we had got all the supplies up on to the land itself. The next few days' travelling brought us to the crevasses which marked the beginning of the land-ice. The crevasses were well bridged and we were able to sledge straight across them. The steepest part of the climb to the 3000-foot pass which we had seen from the aeroplane was the first 700 feet, and we decided that we would get everything up on a series of relays. Then Bingham and I would turn back, while Stephenson, Fleming, and Bertram continued.

At the south end of the shelf-ice where Bingham and I turned back we found a level uncrevassed place, large enough to use as a landing-ground for the aeroplane. We proposed to hurry back the 90 miles to the base, and then, while the dogs were resting and being fed up on seal meat, Hampton could try to fly down to this point a depot of provisions large enough to last us for eight weeks. Bingham and I would then start south again, pick up the depot

and continue on our interrupted journey behind Charcot Island to the end of the Dependencies.

We left everything except our essential gear and a few days' dog food, and started back on September 24. With our light sledges we were able to travel fast, covering the 90 miles in five days in spite of being held up for one day in bad weather. As soon as we returned, Hampton prepared to fly the depot south. We should not have much time for this: we thought the sea-ice in Marguerite Bay would be safe for sledging until the middle of January, but it would be safer to reckon on getting back in the early part of the month, and, as we hoped to be away for ten weeks, this only gave us three weeks to do the five or six flights required for laying the depot.

The kind of flying which we were now going to undertake did not need the perfect weather which is required for aerial surveying and reconnoitring when everything depends on visibility, for we were now going to fly to a known point and would only have a passing interest in the distant scenery. All the same, reasonably fine weather is required for any kind of flying in the Antarctic.

On the day after we returned the usual easterly gale blew, but the next day was better, and Hampton and I took off in the morning; after flying some 70 miles we ran into low cloud, and bad weather forced us to return. It blew hard all that night, but the wind died down during the next morning, and Hampton and I decided to have another try, and took off just after lunch on October 1. When we got about 20 miles from the base we found a strong wind still blowing off the mountains and had an extremely rough trip as far as Cape Berteaux, but south of here the conditions were better and we made a good landing on the shelf-ice after dropping a flag which showed the wind direction and gave a mark to judge our height by. We had made this flight with the aeroplane light, which is a wise precaution when landing in new country, and after unloading the few boxes which we had brought, we flew on farther south to try to find out how Stephenson's party was getting on. After a few miles we picked up their sledge track in the mountains and followed it for about 30 miles until it began to drop steeply down a crevassed glacier into the channel. Lack of petrol forced us to turn back here, but not before we had discovered that Stephenson's party was well on its way south.

Now that Hampton knew where we wanted the depot there was no point in my flying with him, but it would be wise for some one to go in case he was forced down and required assistance. As Riley was the lightest member of the expedition, we decided that he would go with Hampton, and then if they got away early enough in the morning to be able to make two flights in the day he would remain at the depot with a tent and camping gear in case Hampton was prevented from making the second flight. If all went well he would return with the aeroplane in the evening.

By October 10, six depot flights had been completed, which meant that we had all our eight-weeks' supplies on the shelf-ice plus some emergency rations to be left there in case we needed them on the way home, and also 8 gallons of petrol, which would greatly increase the range of the aeroplane. On two occasions Hampton had been able to make two flights on the same day, which

Mountains in the north-east corner of Alexander I Island

The Wordie Shelf-ice, showing in the left background the col through which the sledging parties passed before descending into the Sound. In the right background can be seen the mountains of Alexander I Island

Landing a depot on the Wordie Shelf-ice

Loading for a depot-laying flight

meant that in one day the aeroplane had flown some 360 miles and had left 600 lb. of provisions at a point 90 miles away.

With the extra petrol on the shelf-ice we could carry out a longer flight. We hoped to reconnoitre farther along the route which Bingham and I planned to take on our way west. I considered this flight advisable. Stephenson and Hampton thought they had seen the southern limit of Alexander I Island, but in exploring the country as we had done so far there were surprises round every corner, and I considered that no chance should be lost of reconnoitring with the aeroplane in front of any sledge party.

October 19 was a glorious day and Hampton and I were in the air by 11.15. When we approached the point which Stephenson and Hampton thought marked the southern limit of Alexander I Island, we were flying at 2000 feet, and the visibility was excellent. We were surprised on drawing level with the point to see another one a little farther on and the strait still continuing to the south, and on rounding this point there was yet another. We flew on southwards until we were some 120 miles from the mouth of the channel and 220 from home. By then we had exhausted our safety allowance of petrol, and were forced to turn back. From this, our turning point, the channel continued in a southerly direction for as far as we could see. We flew northwards once more and soon landed at our depot. After stopping here for a short time to stretch our legs after the cramped quarters in the aeroplane, we continued on the last 90 miles back to the base.

We had of course got nowhere near Charcot Island, but we had made the surprising and interesting discovery that the channel continued on in a southerly direction. This discovery, together with the fact that we had seen no possible sledge route from the west side of the channel across Alexander I Island, made it essential for us to time our departure so as to meet Stephenson somewhere on the base side of the channel. We could then find out from him what happened beyond our turning point in the aeroplane and base the plans for our journey on the information which he gave us.

We were held up by the usual gales until October 26. When we eventually started Hampton and Riley came with us for the first few days to lay a depot on Terra Firma Island, and while we were away they were also going to put another one on a group of small islands between Terra Firma and the base. Besides these two depots we had more provisions than we needed on the shelf-ice and could leave a small quantity there. The safety of our return journey would most probably depend on a good system of depots, for we had no idea what the condition of the sea-ice in Marguerite Bay would be in another ten weeks when we hoped to return. We felt particularly glad to know that we had these depots when, on the first day out, we met groups of penguins walking in over the ice from the open sea to their breeding-grounds on the coast. The weather was so unpleasant that it took us fifteen days to reach our depot 90 miles away, and two days after that, on November 11, we reached the top of the 3000-foot pass with half-loads. Here we met Stephenson's party returning. We made a depot of our half-loads and all returned to our camp 2300 feet below.

Stephenson's party had travelled down the channel for 200 miles and from this, their turning-point, they could see the last rock exposure on the

Graham Land side about 10 miles ahead. From here on the country was completely glaciated and ran for some 50 miles slightly west of south before disappearing from sight. To the south-west they could see what appeared to them to be the end of Alexander I Island—a long glaciated point. What happened beyond this point they could not say, but their general impression was that the channel swung round to the south-south-west and widened out considerably, suggesting that it opened into a long bay west of Alexander I Island. They were then 70 miles south of the southern limit of Stefansson Strait, but there was no break in the coast anywhere to the east.[1] On the way back they made two landings on Alexander I Island, and were lucky in finding fossil deposits in both places.

As Stephenson's party reported that there was no possible route across Alexander I Island to the west, we decided to try to cross Graham Land and see if we could explore anything of its east coast. The morning after we met Stephenson was fine and we succeeded in getting the rest of our loads up on to the plateau, which here tilts to the west. We turned east in latitude 69° 50′ and began our long climb, often being held up by bad weather, and having to relay our loads through the deep snow and up the steep slopes. After eleven days we had covered 73 miles from our depot and saw the line of mountains ahead which we thought must be the east coast of Graham Land. Two more days put us right in amongst them, and we made our highest camp at 7500 feet beside a massive peak rising to 9500 feet, and then climbed a smaller one beside it thinking that we would get a view out over the shelf-ice of the Weddell Sea. But on reaching the top, and looking out to the east, we saw the land continuing in the form of a large terrace-like plateau, with more mountain ranges about 20 or 30 miles farther on. The plateau was about 500 feet below us, and we were fortunate in finding an uncrevassed but steep slope leading down on to it. Once on it we travelled due east for 25 miles before reaching the mountains fringing its eastern edge. From these mountains the land fell away steeply in a series of rocky ridges intersected by crevassed glaciers. On the day we arrived at the edge of this second plateau there was low cloud covering what we thought must be shelf-ice farther on; in fact for the thirty days that we were in sight of the east coast there was always low cloud out to the east, and only on two or three days was there enough west wind to blow it back from the land, letting us see the actual shelf-ice. On one of these days it cleared enough for us to see what we took to be low islands lying a few miles off the mainland which was clearly marked by a steep ice-cliff.

As the cloud would make it impossible to see anything from the shelf-ice, we decided to turn south and travel along it, keeping about 3000 feet up on the mainland. We therefore went on about another 10 miles eastwards and then turned south, but we soon got into serious trouble on the crevassed glaciers. After spending a week trying to get to the south, we were forced to return to the plateau with the intention of travelling on it and then striking out to the coast again farther south. We were considerably held up by bad weather, but eventually reached what should have been the north coast of Stefansson Strait. We pitched our camp at an altitude of 6000 feet on what the maps

[1] A more detailed account of the work of A. Stephenson's party will be published later in the *Journal*.

Camp in the Pass Mountains, December 1936

Mountains forming the eastern boundary of the Graham Land plateau

Approaching the Debenham Islands at the end of the sledging season, January 1937

Mount Wakefield

indicated as Lurabee Channel, but were disappointed to see that all the land to the south-east was covered in cloud, except for the higher mountains. However the next day was clear and we were able to see that the land to the south continued first at a lower level, then rising into the highest mountains which we had yet seen in Graham Land, while out to the east the coast-line continued running in a north–south direction. We had not enough provisions left to attempt to penetrate into these distant mountains, and after spending two days surveying and collecting geological specimens we turned to the north to investigate the eastern end of the supposed Casey Channel. After travelling for 40 miles we reached a position overlooking a valley glacier running down from the main eastern mountain chain to the coast. This glacier is in the same latitude as Wilkins' Casey Channel and formed the east end of a rift about 5000 feet high running right across the main plateau.

Bad weather held us up on the south side of this glacier for seven consecutive days, but at last it improved, and on Christmas Day 1936 we turned for home. We had been away from the base for sixty days, and from the depot on the shelf-ice for forty-three days. In all this time we had sledged 340 miles and had succeeded in mapping 150 miles of the east coast of Graham Land.

The last few days of strong wind had put a good surface on the snow and we were soon back at the pass in the main eastern range. From here we were on known ground and had a quick run back across the plateau, averaging 25 miles a day. We found the sea-ice in Marguerite Bay was still holding, though it was much broken up by leads of open water and thaw pools which had rotted large holes. We were able to pick a way between them and arrived back at the base on January 5, completing a journey of 540 miles.

When we returned we were disappointed to hear that, after the aeroplane had laid a depot for us at Terra Firma, there had not been any more flying-weather until the ice became too rotten for the aeroplane to take off. This meant that we should not be able to make the two flights necessary for finishing off our survey until the ice opened up enough to allow us to use floats.

At the end of January, although the greater part of Marguerite Bay was still blocked with ice, there was plenty of open water along the shore, and on February 1 Hampton and Stephenson undertook a flight across Alexander I Island to try to get some idea of its western shore. When they reached the east side near the mouth of the Channel they found they had a strong head wind against them, and while flying at 7000 feet they crawled up a glacier with the 8000-foot mountain tops close beside them. They found that the mountains forming the west side of the channel were a narrow ridge behind which lay a plateau about 4500 feet above sea-level. Beyond this was another plain about 2000 or 2500 feet high, and on the far side of this lower plain there was a large mountain mass lying in an east–west direction, but not extending far to the west of their course which was here almost due south. After flying for some 170 miles and reaching the southern end of the upper plain, they had to turn back. What they saw and photographed has enabled us to make our new Alexander I Island a more reasonable shape, but its western limits are still unknown.

The next and last flight, except for some local survey flights, which we wished to make, was to the north and should enable us to connect up the

surveys done from both our bases. It was carried out by the same two on February 13. They flew up the channel between Adelaide Island and the mainland, coming out into the large bay to the north of it. When they reached the centre of this bay, which was 140 miles from the base, they could get a good view to the north where our previous year's survey finished. They could also see that Crane Channel did not exist as such, but that there was a rift in the plateau down which a large glacier flows. After satisfying themselves on this point they turned for home.

The day before this flight, on February 12, Hampton and I had flown out over Marguerite Bay to look at the state of the ice. We had found it quite open enough for *Penola* to get through, and that night I wirelessed to Ryder (who was holding her at her old winter quarters in the Argentine Islands) telling him that he could now reach us. After being blown considerably out of her course by a north-easterly gale, the *Penola* eventually reached us on February 23.

The ship's party, after they left us the year before, had taken the ship back to the Falkland Islands under sail alone, where Roberts had his appendix removed, and then, as Ryder considered a refit necessary, they sailed in the winter from the Falkland Islands to South Georgia, where whaling companies very generously gave us the use of a floating dock, materials, and skilled workmen. After the refit they made another passage, still under sail only, back to the Falkland Islands, and from there a long and difficult one to pick us up again. They found that seven was too small a number to handle the ship during these long passages, and her crew had been increased by one man and three boys from the Falkland Islands.

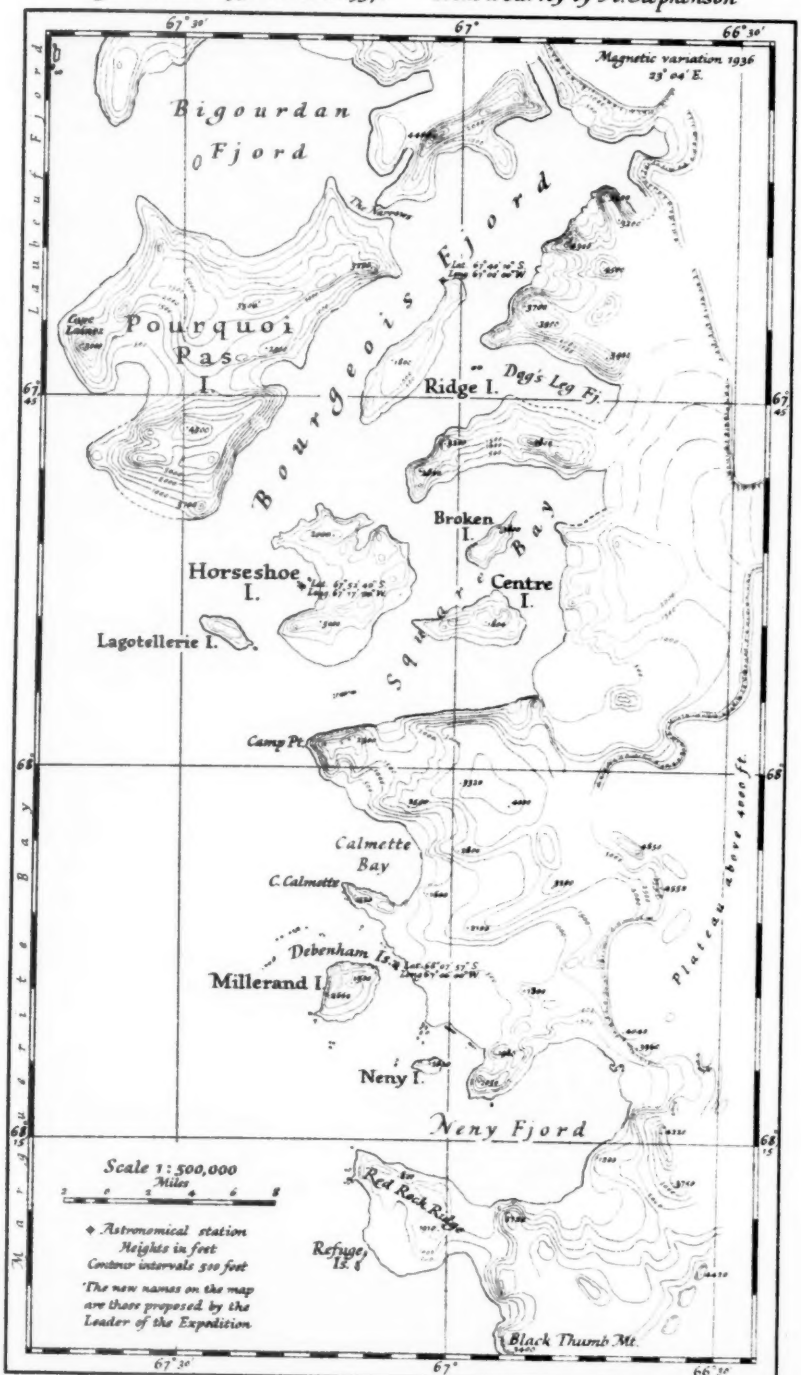
Loading was held up by our usual strong winds, but we eventually sailed for home on March 12. As it was now so late in the year we decided to see where the edge of the pack-ice was, and after leaving Marguerite Bay we headed south-west and found the edge of the pack as it is indicated on the folding map (following p. 496).

After an uneventful voyage we arrived at South Georgia on 3 April 1937. Here the shore party left the *Penola*, as we were very kindly offered free passages home on one of Messrs. Salvesens' transports, while the ship's party, with the addition of Moore, began their long sail home, eventually arriving at Portsmouth on 10 August 1937.

In conclusion I should like to express my sincerest gratitude to the expedition's many supporters, and especially the Colonial Office, the Royal Geographical Society, the Corporation of the City of London, Lloyd's, Lord Wakefield, Major Moore, Mrs. Henry Cadbury, Doctor Robert Fleming, Sir Arthur and Lady Bagshawe, Mr. K. P. Birley, Mrs. Patrick Ness, Lord Luke, Lord Leverhulme, Lord Cadman, Mr. Louis Clarke, Lord Weir and the Hon. J. K. Weir, Mr. William McC. Meek, Mr. E. D. Naess and Messrs. Salvesens, all of whom combined to make the expedition financially possible. I am also indebted to the Admiralty and War Office for their generous loan of personnel and equipment, and to Admiral Sir William Goodenough, Vice-Admiral Sir Percy Douglas, Professor Frank Debenham, Mr. James Wordie, Mr. Hinks, and Augustine Courtauld for their valuable assistance and advice, and especially to J. M. Scott, who acted as our Home Agent.

SOUTHERN BASE, MARGUERITE BAY

B.G.L.E. March 1936 – March 1937. From a survey by A. Stephenson



Published by the Royal Geographical Society

Note on names used on expedition maps

In the expedition maps published in the *Journals* for April and May, and in those which will accompany subsequent articles, a number of new names will be found and also certain changes where previous names have been transferred from one feature to another. At the time of writing these alterations and additions have received the approval of the Antarctic Names Sub-Committee of the Polar Committee, and now only await the approval of the ultimate authority before they can be accepted as final.

In the choice of new names, as far as possible descriptive names are used, but in addition it was found necessary to use personal names, and when such was the case names were chosen from members of the expedition committee, from benefactors to the expedition, or from scientists and explorers who had worked in or around the locality concerned, the outstanding exception being the name given to the chief geographical discovery which the expedition made, for which His Majesty has graciously approved of the name King George VI Sound.

Concerning the change of names, the following notes may be of interest:

Alexander I Land: Bellingshausen and Charcot both referred to this land as Alexander I Land, and it was not until after Sir Hubert Wilkins' flight of 1929 that it appeared on the map as Alexander I Island. Wilkins thought that there was no land immediately south of the Havre Mountains and claimed that Alexander I Island was insular and about 50 miles in diameter. Since it was portrayed as such on the maps used by the expedition, the term "Alexander I Island" has been used throughout the account of the preparation for, and the work of, the expedition. As a result of the expedition's surveys however it is now known that this land is some 300 miles long and of unknown width, and is considered worthy of the name Alexander I Land, the form which it takes on the expedition's final map.

Matha Strait: This is used instead of Matha Bay which was the original name given by Charcot. This part of the map is very different from Charcot's original, and the term "strait" seems more suitable than "bay," since it is merely the entrance leading into Marin Darbel Bay, between the south end of the Biscoe Islands and the north end of Adelaide Island.

Owing to the simplification of the coast in this region there is a surplus of names which has led to an error in the map published in the April *Journal*. In this map entitled "The Graham Land coast," the following alterations should be made:

For Cape Evensen read Cape Bellue.
,, Cape Waldeck Rousseau read Cape Evensen.
,, Pillar Peak read Mount Waldeck Rousseau.

It is hoped that these corrections will be made in any future reprint of this particular map.

Pitt Islands: The problem as to the position of the island which Biscoe saw and on which a landing was made in 1832 is still unsolved. Biscoe's description of the island might well apply to any of the ice-covered groups of islands in this part of Graham Land. From the air it was seen that what Charcot had called Pitt Island was a group of ice-covered islands which from sea-level can very easily be mistaken for a single island. For this reason the name Pitt Islands is used instead of the single Pitt Island. The position of this group however in no way agrees with that assigned to them by Biscoe. The difficulty lies in the fact that Biscoe describes them as lying fairly close to the mainland, so much so that at first he mistook them for part of the mainland, but in plotting his position, which he claims was a good one, they are found to lie some miles out to sea.

Even after applying a correction for longitude based on a comparison of his longitudes with other known positions, the island still lies some miles west of the present plotted position. The conclusion is that either there is something radically wrong with his position or else there are some islands lying out to sea seen by Biscoe but which have never been seen since.

Hearst Land and other names in South Graham Land introduced by Sir Hubert Wilkins have, for the time being, been omitted altogether pending a more detailed comparison between the B.G.L.E. surveys and those of Ellsworth and Wilkins. It is hoped that by the time the map of King George VI Sound is published some conclusions will have been made concerning the relation which the features named by Wilkins bear to those mapped by the B.G.L.E.

DISCUSSION

Before the paper the PRESIDENT (Professor HENRY BALFOUR) said: This is the first meeting of our new session and I think we are opening very auspiciously with a communication of great importance. We are to hear an account of the British Graham Land Expedition, which occupied something over two and a half years. Its results cannot therefore easily be condensed into a short space of time such as we have at our disposal this evening, and details of the scientific work will be left to other meetings.

The leader, Mr. John Rymill, is going to give us this evening a narrative describing the general story of the expedition; but even a narrative which covers two and a half years or more is likely to be difficult to condense. Thus, without further preamble, I offer Mr. John Rymill a most cordial welcome on your behalf, and ask him straight away to deliver his lecture.

Mr. Rymill then read the paper printed above, and a discussion followed.

The PRESIDENT: Mr. Hampton was second-in-command and air pilot. I hope he will supplement what the leader has said.

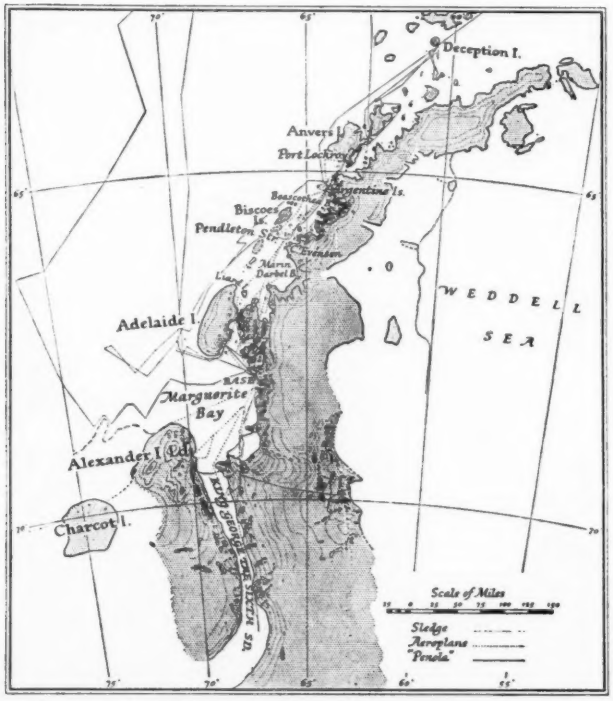
Mr. HAMPTON: Rymill has concluded his lecture by voicing the thanks of the expedition to those to whom we are so much indebted, but there is another debt of gratitude which it is my pleasure to make public to-night. Before and after an expedition there is a good deal of work to be done by the various members, and everybody is very busy. Our individual work was very specialized however, and as long as we got what we wanted in our respective branches we were satisfied. We had not the responsibility of obtaining sufficient financial support —perhaps the most heart-breaking task that has to be faced by any leader—or of deciding whether £10 or £100 saved in one section could not be more usefully spent in another. These responsibilities, and many others affecting the work and the welfare of the expedition, eventually fell on Rymill's shoulders. Fortunately those shoulders are broad, for the organization of an expedition and the carrying of it through are not tasks to be undertaken light-heartedly. Many of us have been able to do work which, besides furthering the aims of the expedition, has been of great value to us at home. I therefore welcome this opportunity, on behalf of myself and the rest of the expedition, to thank Rymill for the chance he gave us of accompanying him, and for the many weeks of work put in outside actual expedition time which have made the whole thing possible and, I venture to say, a success.

The PRESIDENT: Lieutenant Ryder, R.N., has fortunately been able to absent himself from his present duties to be with us this evening. As he was responsible for getting the expedition to Graham Land and bringing it back again I think it will be agreed that a debt of gratitude is owing to him. I ask him to add a few words.

Graham Land and the routes of previous expeditions up to 1934

Graham Land as it appeared after the southern sledge journey

Graham Land as it appeared after the flight of 13 March 1936



Graham Land as known in 1937

Lieut. R. E. D. RYDER, R.N.: I was asked to prepare a few words about the *Penola*, but I am afraid that I find it somewhat difficult to say anything very complimentary about the old ship. As a sailing vessel she was not a good performer, and motoring was not exactly her strong suit either. She had one remarkable asset, in that she was entirely free from all forms of vermin.

To turn however to more serious matters, there is the question of the crew. In our case, instead of able-seamen we had men of a very different type, unpaid in the first instance, and of much higher intellectual standards than the ordinary professional seaman. Before going further I would like to say I was very much struck by the cheerful way in which these people carried out their duties on board in spite of sea-sickness and other adversities. It was not always pleasant work and I think they deserve a great deal of credit, especially those who remained with the *Penola* throughout. But as regards this system in general, and the handling of a ship with an amateur crew, I would like to make one or two comments for the benefit of any one who may contemplate repeating the experiment. This type of person has not the same power as the professional seaman for maintaining an interest in routine work. On the other hand, in an emergency the man who has had the responsibility of being a gentleman stands out at once. Finally, this system seems to interfere with scientific work, though that might possibly be overcome. Any one who contemplates organizing an expedition on our lines will, I think, find he is faced with much the same problems; they are interesting and worth considering.

In commenting on the ship I in no way wish to reflect on Mr. Rymill's organization, nor on the ability of Mr. Meek, who most nobly helped and advised us while fitting out. Many of the limitations and decisions were unavoidably influenced by the financial considerations, and the arrangements had my entire approval when we left England.

Before sitting down, I should like to pay a tribute to Mr. James Martin, who was my chief officer and had the handling of these complex social and domestic problems on board. He is, I think, the only person I know who could have carried out the job with such conspicuous success. Lieutenant-Commander Millett, our chief engineer, had the most trying time of all. The fact that the *Penola's* engines were able to complete the entire voyage was nothing short of miraculous. He certainly deserves a very great deal of credit. I wish also to add a word of thanks to my brother who, although my elder by a number of years, consented to come as my second officer. His ability as a shipwright served us in very good stead and I consider I was very lucky in having him with me.

Sir HARRY BATTERBEE: I have listened to many interesting stories in this hall, but I do not think I have heard a more fascinating or interesting story than that to which we have listened to-night.

One point struck me when I saw the list of polar explorations shown on the corner of the map early in the lecture, namely, the number of expeditions that there have been during the last decade as compared with the number during the last one hundred years. To those of us who are interested in polar exploration it is a source of gratification to realize what a live interest there is in the subject and that the increase in the amount of exploration has brought a larger recognition of the importance and value of the scientific problems connected with polar regions. We have all now, I think, come to realize the interest and importance of those problems. No one, after listening to the lecture by Mr. Rymill, could ask whether it is all worth while.

Two points struck me during the course of the lecture. Firstly, the comparative youth of those who have conducted and organized recent polar expeditions as compared with the maturity of years and experience of the older

explorers. That is an interesting fact. But in spite of the youth of the explorers they have filled up many of the blanks of knowledge left by older explorers. Like other new brooms, they have swept away some misconceptions. The other point which struck me was that, in spite of the advance of science, polar explorers still rely largely on the old means of transport. Though the aeroplane and motor may be useful auxiliaries, explorers in these regions must rely on their own feet, on the sailing ship, and on the dog. This may be the reason for the fascination of polar exploration. It must be a great thing to be engaged in an adventure in which one has to rely solely on one's own powers of body in the struggle with Nature. So long as we have young men ready to go out in that spirit, I do not think we need despair of the race. So long as there is a succession of young explorers such as Gino Watkins and John Rymill and his band of fellow adventurers, good work will be done.

Sir HERBERT HENNIKER-HEATON: I am very glad to have the opportunity, on behalf of the Government of the Falkland Islands, of publicly thanking Mr. John Rymill and those associated with him for the magnificent work they have done in correcting and filling in the map of the Dependencies. I have listened, as you have, with the greatest interest to all we have been told to-night. I knew very little about the expedition when I went out to the Falkland Islands in 1935 except that Mr. John Rymill and his fellow explorers had completely won the hearts of everybody who had had anything to do with them. As regards the *Penola*, the wiseacres in the Falkland Islands were quite satisfied that if the ship ever got south she would never return. I am quite sure that we all feel that Lieutenant Ryder and the officers and crew of the *Penola* are definitely in the high tradition of the British seamen-adventurers from the sixteenth century onwards.

Mr. J. M. WORDIE: Those who have been in the Antarctic on previous expeditions know that Rymill's has been a worthy successor to those of Scott, Shackleton, and Mawson. Rymill's has been of very different type however, run on more economical lines, and with the interesting experiment of an amateur crew. Lieutenant Ryder has spoken quite freely about this, and I should like to add a word from my own experience. Shackleton in 1914 was also planning to take an amateur crew, but he soon found out its weaknesses, and in the end the crew of the *Endurance* had to be stiffened up with old hands. I can certainly agree therefore with much that Lieutenant Ryder has said about the advantages and disadvantages of an amateur crew.

Rymill has started a new style of Antarctic exploration, less ambitious than the expeditions of the past, working at shorter range and more exhaustively, and concentrating on certain definite problems. I hope and feel sure that many others of the same type will go again to the Antarctic in the near future. As you can see from the map there is still a big area to explore, both in Graham Land itself and westwards south of the Pacific to the Ross Sea. There is plenty of scope there for extending the work which Rymill and his party have so well begun, and though they were first in the field they have by no means exhausted a very tempting region.

Dr. H. R. MILL: Looking back over the forty-five years during which I have been associated with this Society, I can remember the beginning of the modern exploration of that portion of west Antarctica which Mr. Rymill's expedition has been the last to visit. This Society encouraged and equipped the Dundee whalers who went out in 1892 with little result. Norwegian whalers in the following year laid the foundations of the great whaling industry which has so completely disproved Captain Cook's dictum that the Antarctic regions could never be of any benefit to mankind.

Several points were suggested to me by Mr. Rymill's paper, but they have all been taken up by the previous speakers. Let me simply repeat the three essential features that strike me as distinguishing this expedition from the others which have gone out to the same region. The first is the successful combination of the latest methods of exploration—the aeroplane, the tractor, the wireless, and the rest, which have been carried out as the sole resource of certain recent expeditions—with the old-fashioned but still essential elements of the strong, sound men with the spirit of youth in them, aided by dogs bred actually on the scene of their labours and guided by men who knew how to drive them. The ship too, though driven by an engine the power of which has been referred to in uncomplimentary terms, could fall back on the old fore-and-aft sails directed by men who were sailors of whom Weddell and Biscoe might have been proud. That the *Penola* reached her winter quarters under sail is one of the most remarkable of the many remarkable features of the expedition.

The second point is the way in which Mr. Rymill has eliminated the terrible privations which form such a large part of the volumes describing the explorations of previous travellers in those regions. Hardships they had, but only of a kind that served as stimulus and strengthening to men who met them with a laugh, and carried out their work with more efficiency than their predecessors because they were better sheltered, better clothed and, above all, better fed. The fact that wisdom may be derived from the errors of the past was a help to Mr. Rymill in making the plans which he was able to carry out successfully.

The third point I wish to stress is the discovery of one of the most important features of the Antarctic continent: that wonderful channel running south which positively gapes for a new expedition, and an expedition that I think this meeting must admit should be under the British flag and at an early date.

I have spoken after a great many Antarctic explorers who have returned to this Society, and I have pointed out how deplorable it would be if the young men, fully trained and fired with courage to go again to the Antarctic, were allowed to drift away into other occupations, and if the invaluable experience they have accumulated were to be wasted. Later new men, possibly inferior in quality, have to be found for a long-delayed expedition and, possibly, make the same mistakes as their predecessors. This time I hope that the young men who have done this wonderful piece of exploration, and who may still see visions of the award *Ob terras reclusas*, will be supported by the dreams of the old men who may possibly share the glory of discovery by providing the funds which will make everything possible.

I wish in conclusion to express my appreciation of the work of Mr. Rymill and his partners and my admiration of the way in which this Society, whose Royal Premium was awarded to Biscoe for the discovery of Graham Land and Enderby Land one hundred years ago, has promoted the expedition which has enabled Rymill to set his feet first of all men upon that part of the Antarctic continent which was seen by Bellingshausen one hundred and sixteen years ago.

Admiral Sir WILLIAM GOODENOUGH: Five or six years ago Mr. Amery at one of our Annual Dinners spoke of the possibilities of the polar route (he was speaking of the north) becoming the air route of the future connecting Europe and America. I remember saying to him afterwards: "That was a fine flight of fancy." It has become a flight of reality. Some will say that that is all very well for the north, but in the south, with the great heights of the Antarctic continent, a South Polar flight is not a practicable proposition. The distance from Hobart to Punta Arenas is little more than 5000 statute miles, or forty-eight hours' flying, and with technical improvements and with perhaps landing places and refuelling bases made as the results of such exploration and research as

Mr. Rymill's, the possibility of the Antarctic aerial route is a practical proposition. We have recognized the importance of these matters by recommending to His Majesty that the Patron's Gold Medal be awarded to Mr. Lincoln Ellsworth for his work in polar aerial research.

Does everyone realize the responsibilities and anxieties for the leader and captain of the ship that must attend such expeditions? It is for the President to speak of the leader. I may be allowed to say a word of the captain of the *Penola*, my brother officer Mr. Ryder. He had a splendid crew, but when they left England few had much nautical experience, and when one thinks of the many thousands of miles covered under sail, the visits to uncharted waters, the bad holding ground and unsafe harbours, and many gales of wind, I think all will agree that it has been a fine display of reliance, of seamanship, and of determination.

Sir Harry Batterbee spoke of the youth of the party and asked a question. May I give him an answer? Reference to past exploration will show that explorers of the past were little older. It is time that we gave up speaking of them with almost astonished admiration as young men. Let us rather profit by their advice and decisions, for in truth they know more about it than we do.

The PRESIDENT: I think we have had a very profitable start to our session, and I am quite sure you will agree with me that this expedition has been one which it was eminently worth while to carry out. It has brought an immense amount of fresh information of great value, and in a variety of ways has extended our knowledge of this rather mysterious continent.

There are certain outstanding features in the results of the expedition. The crossing of the southern part of Graham Land is one of them, and of many others one might mention the mapping of the coast-line of Marguerite Bay, which was unknown. But perhaps the most striking of all is the establishment of the great waterway lying between Graham Land and Alexander I Island. That is a real triumph. Its full extent is at present not known, and one can only endorse what other speakers have said when they have expressed the hope that fresh expeditions will be forthcoming in order to supplement the present one.

Many uncomplimentary remarks have been passed on the *Penola*, but in spite of her weaknesses, in spite of the fact that she was merely an old, semi-retired Breton fishing boat to start with, she did 30,000 miles; and at the end of her journey she still continues to serve. This old servant of the expedition was sold, and the money which she realized has gone towards wiping off the adverse balance. Furthermore, she still remains in commission as a training ship for embryo seamen. I feel I must say these few words in praise of the vessel which has not been thanked whole-heartedly by others.

It is not for me to say much about the expedition. I would however like to refer to one very striking feature, and that is the way in which the health of the party was maintained throughout two and a half years in what is, after all, one of the most uninhabitable areas of the globe. That speaks very well for the surgical staff, consisting of one member. And, when you come to think of it, his cannot have been a very easy job, because this party of sixteen was scattered in all directions in small units. With the exception of one or two instances of ill-health, the entire party returned not only none the worse for their enterprise but seemingly very much the better. So we are grateful to the surgeon, and also grateful for the organization by the leader which led to such an extraordinarily happy result.

I am sure before we close the proceedings you would all wish to express your very hearty thanks to the leader, Mr. John Rymill, and you will wish to include in your thanks the whole of his party, which has done such admirable work.

THE POPULATION OF TURKEY IN 1935

A. A. PALLIS

IT is a well-known fact that under the rule of the Sultans no effort was ever made to carry out an accurate and scientific census of the inhabitants of the Ottoman Empire, owing to the opposition that such a measure would have encountered on the part of the Muhammadan section of the population. The notions then prevalent concerning the seclusion of women formed an insuperable bar to an effective enumeration of the women and children, and any attempt to ascertain their numbers would have been resisted as an intrusion into the jealously guarded privacy of the Moslem home. In the Albanian, Arab, and Kurdish provinces in particular, where the authority of the Government was habitually defied, the census officials would have been given as short shrift as the tax-gatherers. Estimates of the population were made from time to time on the basis of incomplete and arbitrary data, but these were far from reliable, and were largely a matter of conjecture. Only in the case of the various racial and religious minorities—Greeks, Armenians, Jews, etc.—were the figures ascertainable with tolerable accuracy thanks to their ecclesiastical and educational organization, illiteracy being much less common among the Christians and Jews than among the Moslems.

Since the proclamation, in 1923, of the Turkish Republic which has swept away so many of the prejudices of the past, the objections of the Moslem population to the taking of a census have been overcome, or at any rate not allowed to interfere with the carrying out of so indispensable a measure. Thus, during the last ten years, there have already been two censuses, the first taken on 28 October 1927 and the second on 20 October 1935.[1] The results have been published in considerable detail in a number of volumes issued by the Central Statistical Office at Ankara. The figures are given by provinces (*vilayets*) and districts (*cazas*), following the new administrative division of 1 June 1935 by which the country was divided into sixty-two vilayets instead of the former thirty-three vilayets and independent sanjaks. The population of the 401 principal towns and boroughs is also given separately. Besides the territorial classification, cross-classifications are also given according to nationality, religion, mother tongue, age, literacy, and profession. From the latter tables it is possible to deduce highly interesting data concerning the present racial distribution of the population and their linguistic and religious affinities.

After the break-up of the Ottoman Empire in 1918 through the secession of the Arab provinces ('Iraq, Syria, Palestine, Arabia, etc.) and the reduction of Turkey to its present limits, various computations of the population based on unofficial and uncertain data were made by certain foreign authorities. These varied from 7,000,000 (French Foreign Office estimate 1924) to

[1] The figures in this article are taken from recent Turkish official publications—the *Annuaire Statistique*, vol. 8 (1935/36)—which contains the results of the Censuses of 1927 and 1935, and the *Récensement Général de la Population au 20 October 1935 (Province d'Istanbul)*, vol. 28 (1936).

The administrative divisions on which the 1935 census in Turkey was based

9,000,000 (British Foreign Office estimate 1924).[1] When therefore the results of the first Turkish official Census of 28 October 1927 were published showing a total population of 13,648,270, there was considerable surprise and scepticism and the accuracy of the figures was openly questioned in many quarters. The second Census however taken on 20 October 1935, which was more thoroughly organized than the first, showed a population of 16,200,694. Further, the publication of the detailed analytical tables and cross-classifications of the 1927 Census would appear finally to dispose of the doubts mentioned above.

The following table gives the figures of the two Censuses for European and Asiatic Turkey respectively:

	1927	1935	*Difference*
Turkey in Europe ..	1,040,669	1,266,132	+225,463
Turkey in Asia	12,607,601	14,934,562	+2,326,961
Total	13,648,270	16,200,694	+2,552,424

The increase of 2,552,424 shown by the Census of 1935 cannot of course be solely attributed to the normal annual excess of births over deaths which, judging from the figures of other Balkan countries, is hardly likely to exceed seven per thousand, but must be put down in great part to the more effective organization of the Census which resulted in a completer enumeration of the population, both sedentary and nomad.

A comparison of the population with the area shows that even the figure of 16,200,694 means a very low density of population as compared with the rest of the Balkan countries.

	Area square kilometres	*Population* 1935	*Inhabitants per square kilometre*
Turkey in Europe ..	23,975	1,266,132	52·8
Turkey in Asia	738,761	14,934,562	20·2
Total	762,736 [2]	16,200,694	21·2

The above gives a general average of 21·2 inhabitants per square kilometre, as compared with Albania 38·1, Greece 51·9, Bulgaria 59·1, Yugoslavia 59·4. Only in Turkey in Europe, which contains the densely populated urban district of Istanbul, does the average (52·8) approach that of the above countries. In Asiatic Turkey, where the general average is only 20·2 inhabitants per square kilometre, the average varies between 29·7 in the coastal regions of the Black Sea to 8·7 in the sparsely inhabited eastern provinces, where a large portion of the population—both Moslem and Christian—perished during the Great War.

The tables giving the classification of the population according to nationality (*sujétion*), religious persuasion and mother tongue reflect the profound

[1] These figures, including an estimate of 8,000,000 made by Colonel Cornwall, G.S.O.I., Army of the Black Sea, Constantinople, are quoted in A. Toynbee, 'The western question in Greece and Turkey' (1925), p. 211.

[2] This does not include the area of the marshes (1170 square kilometres) and lakes (8434 square kilometres).

changes which have taken place in the racial composition of the population of Turkey during the last twenty-five years. An ethnical map of eastern Thrace and Anatolia showing the different races and religions at the beginning of 1912 before the outbreak of the first Balkan War would have been covered with innumerable coloured blotches. At that time there were estimated to be between 2,200,000 and 2,500,000 Greeks and about 1,500,000 Armenians, besides Assyrians, Jacobites, and other Eastern Christians. The ravages of war, wholesale emigration, and the formal exchange of populations between Greece and Turkey in 1923–24,[1] have resulted in a much greater degree of racial homogeneity. The following table, which has been compiled by coordinating the three tables which give the classification of the population by nationality, religious persuasion, and mother tongue at the Census of 1927,[2] shows the approximate [3] distribution of the principal racial elements in round numbers:

Race	*Turkey in Europe*	*Turkey in Asia*	*Total*
Turks	774,800	10,961,200	11,736,000
Kurds	1,700	1,182,300	1,184,000
Arabs	—	134,000	134,000
Circassians	100	95,900	96,000
Albanians	5,000	15,000	20,000
Tartars	400	10,600	11,000
Pomaks	1,000	9,000	10,000
Greeks	77,000	—	77,000
Armenians	50,000	27,000	77,000
Bulgars	2,000	1,000	3,000
Jews	45,000	37,000	82,000
Unclassified	18,000	114,000	132,000
Foreign subjects	65,000	21,000	86,000
Total	1,040,000	12,608,000	13,648,000

According to the above table, there are about 13,191,000 Moslems, 160,000 Christians, and 82,000 Jews (excluding the unclassified population and foreign subjects).

Of the Moslems of non-Turkish race, the Kurds are mainly concentrated in the north-eastern and south-eastern provinces of Anatolia, the Arabs in the south-east. The Circassians are "muhajirs" [4] (or their descendants) who emigrated from the Caucasus after the Russo-Turkish Wars of 1856–78; these are scattered in small colonies over the greater part of Anatolia. The Albanians—mostly muhajirs from the Albanian districts of Macedonia

[1] Under the Lausanne Convention of 23 January 1923.

[2] The corresponding figures of the Census of 1935 have not yet been published, except for the Province of Istanbul.

[3] It is not possible to give the exact distribution owing to certain lacunae in the classification, *e.g.* the Albanian-speaking population includes both Christian and Moslem Albanians, but the figures for each are not separately stated.

[4] The term "muhajir" (or *muhacir*, according to the new Turkish spelling) is applied to all Moslem refugees or émigrés from a non-Moslem to a Moslem country.

occupied by Serbia—came in during or immediately after the Balkan Wars of 1912–13; these are also scattered about in western Asia Minor. The Tartars, who are muhajirs from the Dobruja and coastal regions of Romania, are settled in the neighbourhood of Eskişehir and on the Bosporus. The Pomaks (Bulgarian-speaking Moslems) are muhajirs who left the Rhodope mountain region during or after the Balkan wars and were settled in western Asia Minor.

Of the Christian elements, the Greeks, as the result of the exchange of populations between Greece and Turkey, are to-day confined to the district of Istanbul, which was excluded from the exchange. The 80,000 Greeks shown in the table are Turkish subjects; that is, the figure does not include Greeks of Hellenic nationality. The latter, according to the 1927 Census, numbered 23,552, a figure since reduced to 16,339 (1935 Census) through emigration as the result of the application of the Turkish Labour Law of 1932, which excluded foreigners from the exercise of a large number of trades and professions. The Armenians are also in the main restricted to the Istanbul urban area. At the time of the 1927 Census there were some 50,000 of them in that city. The remaining 27,000 are scattered about in various parts of Anatolia.

The racial does not coincide absolutely with the linguistic distribution, the two overlapping to a certain extent. This is due to the fact that part of the Greek, Armenian, and Jewish population are Turkish-speaking, whereas part of the Turkish population (the muhajirs from Crete and Epirus) speak Greek as their mother tongue. The following table shows this (1927 Census figures):

Greeks (Turkish subjects):		
Greek-speaking	57,299	
Turkish-speaking	14,793	
Armenian-speaking	5,139	77,231
Armenians:		
Armenian-speaking	59,606	
Turkish-speaking	17,827	77,433
Jews:		
Yiddish-speaking	68,900	
Turkish-speaking	9,319	
Spanish-speaking, etc.	3,653	81,872

The number of foreign subjects established in Turkey, which before the War was considerable, particularly at Constantinople, Smyrna (İzmir), Mersina (İçel), and other port-towns, has greatly diminished as the result of the restrictions imposed on the employment of foreigners, and the nationalization of a large number of public administrations and concerns formerly under foreign management and to a great extent staffed by foreigners. The Census of 1927 showed a total of 85,469 foreign subjects in Turkey distributed as follows:

Country	*Turkey in Europe*	*Turkey in Asia*	*Total*
Greece	23,552	2,879	26,431
Italy	6,884	4,689	11,573
Persia	5,316	—	5,316
Russia	5,333	873	6,206
Bulgaria	4,871	2,577	7,448
Yugoslavia	2,893	990	3,883
Great Britain	2,225	1,188	3,413
France	2,079	1,348	3,427
Germany	1,288	1,018	2,306
Albania	1,251	401	1,652
Romania	1,076	454	1,530
Unclassified [1]	8,000	4,284	12,284
Total	64,768	20,701	85,469

These numbers have been still further diminished during the period which elapsed between the two Censuses as the result of the enforcement of the Law of 1932. This has led to a reduction in the number of Greek, Italian, British (mostly Maltese), Yugoslav, Iranian, and other subjects. The effect of the law on the foreign population of İstanbul is reflected in the figures of the 1935 Census for the vilayet of İstanbul which shows a total of 42,707 —a diminution of about 22,000 as compared with the Census of 1927. The biggest diminution is in the number of Hellenic subjects which from 23,000 has fallen to 16,000.

Parallel with the outward movement of foreigners and other non-Turkish elements of the population there has been a steady influx, since 1923, of Turkish Moslem immigrants from Romania, Bulgaria, and, to a lesser degree, Yugoslavia, all of them countries in which there still remains a considerable Turkish population. The Turkish Government is encouraging this immigration with which it hopes gradually to fill the gaps left by the departure of the Greeks and Armenians.

It is interesting in this connection to note a fundamental change in the attitude of the present Nationalist regime in Turkey towards Moslem immigration as compared with the past. In the days of the Ottoman Sultanate, when the prevailing spirit of the Government was Islamic rather than Turkish, all Moslems, irrespective of their racial origin or speech, were welcomed as settlers within the Empire. The new Turkey, which is a secular and nationalist state imbued with the idea of racial and linguistic homogeneity, is much more exclusive in its immigration policy. Article 1 of the Turkish Immigration Law (Iskiân Kanunu) of 1934 lays it down that immigrants must belong to races of Turkish cultural affinities. This means that only persons of Turkish stock and Turkish speech are to be admitted. Bosnians, Albanians, Pomaks, and other non-Turkish Moslems are therefore excluded. It is anticipated that in the course of the next twenty years the whole of the remaining Turkish-speaking population of Romania, Bulgaria, and Yugoslavia, and probably

[1] Approximate distribution.

portions of the Turkish and Tartar populations of the Crimea and other parts of Russia, will have emigrated to Turkey.

According to figures published by the Turkish Settlement Department (Iskiân Mudirieti),[1] the number of immigrants admitted into Turkey during the years 1921–1927 was 434,079. This figure must be taken as including only those immigrants who were settled directly by the Government. The Turks from Greece exchanged under the Lausanne Convention of 1923 alone numbered 400,000. Those from the other Balkan countries certainly exceeded 34,000.

According to a fairly reliable estimate the total number of Moslem muhajirs who entered Turkey since 1912, including refugees, émigrés, and "exchangeables," is in the neighbourhood of 900,000, of whom about 600,000 have come in since 1920. The majority of these have been settled in the Edirne, Kirklareli and Tekirdağ (Rodosto) districts of eastern Thrace and in the Bursa, Balikesir, İzmir, Samsun, Trabzon, and Giresun districts of Anatolia. Against this immigration must be set a certain exodus of Kurds, Jacobite Christians, and Jews from the south-eastern vilayets of Anatolia (Urfa, Mardin, Siirt, Malatya, etc.) into Syria, where they have settled in the district of Upper Jezira just across the border.

As the very low density of population shows, Turkey is still capable of absorbing large numbers of new settlers, as she is in the fortunate position of possessing huge areas of undeveloped land, particularly in central, southern, and eastern Anatolia. The Turkish Government is proceeding systematically with its colonization scheme, at the rate of about 35,000 immigrants a year. During the last two years most of these have come from Romania, with whom Turkey concluded an agreement in 1935 for the gradual emigration of the Turks of the Dobruja.

The rapid improvement of communications under the republican regime, as well as the development of the Public Health Services, a vital factor in the success of any colonization scheme, will greatly facilitate the settlement of the more remote parts of Anatolia. If the present rate of progress is maintained, Turkey in the not very distant future will be able to boast of a population of twenty millions.

[1] See *Annuaire Statistique* (vol. 1, 1928), pp. 36–38.

SOME NOTES ON PART OF THE GWEMBE VALLEY IN NORTHERN RHODESIA

F. B. MACRAE

AT the Victoria Falls the Zambezi river plunges into a narrow gorge with precipitous sides, some 400 feet deep. The river, which above the Falls attains in one place a breadth of 2 miles, is confined in a rocky channel only a few yards broad. This gorge continues for more than 40 miles down stream from its point of origin and finally debouches into what is generally known as the Gwembe valley. The sides do not remain uniformly steep for, although isolated rocks and cliffs stand out at intervals, numerous streams and rivers flowing down on either hand have cut back the sides of the gorge and made access to it generally no easy task in the immediate vicinity of Victoria Falls. At the same time these tributary waters have created on either side of the Zambezi an ever-widening strip of mountainous, inaccessible, and uninhabited country.[1]

The Zambezi in this part of its course has no very large affluents. The first tributary is the Kalomo river which flows in on the left bank somewhere about 25 miles below the Falls. The exact distance has never been accurately determined, and so far as I know no one has ever explored this section of the river and left any record of the journey.

At the Kalomo confluence the gorge is bounded by steep hills and the Zambezi is on an average 100 to 150 yards broad. Thirty miles below the Kalomo the Matetsi river joins on the right bank, and 15 miles below the Matetsi the Deka; another 15 miles and the Gwaai confluence is reached. Both the latter join from the right bank. I have been at the Deka confluence but not at either the Gwaai or Matetsi confluences. Below the Gwaai river one may be said to enter the Gwembe valley.

Gwembe is the Matabele name for the Zambezi but it has now become attached to the whole district. The inhabitants are Batonga, the majority of whom appear to have come into the area about one hundred years ago, according to their own traditions. At this time they say that the valley was uninhabited. They also say that they came from a country called Bunyai farther down the river; this name is still to be found on the maps as Banyai, a tribe who were at one time prominent on the lower reaches of the Zambezi.[2] The Banyai were also associated with the Makalanga, a number of whom live with the Batonga in the Gwembe valley at the present day. The people are also sometimes known as the Bawe, which may only mean "the people from the east," and Livingstone called them the Ba Enda Pezi, "the people who go naked."

The first recorded European to approach the Gwembe valley was Dr. Livingstone, who skirted its extreme eastern limit at the Kafue–Zambezi

[1] Some account of this country appeared in the *Geogr. J.* 76 (1930) 59–63; and 78 (1931) 53–55.

[2] The Banyai are a rather obscure people. For further references to them see F. J. M. de Lacerda, 'The lands of Cazembe' (translated by R. F. Burton), 1873; D. Livingstone, 'Missionary travels and researches in South Africa,' 1857, p. 617; D. and C. Livingstone, 'The Zambezi and its tributaries,' 1865, p. 141; E. H. Lane Poole, 'Native tribes of the East Luangwa Province of Northern Rhodesia,' p. 23.

The Sebungwe confluence

The Muga river and Bwenekabanga mountain

The Muga river in the hills below the Nakenga falls

The Zambezi at Sijoba

Sikadinga rocks on the Zambezi

Dry bed of the Bomu river in the escarpment

confluence in 1855–56. In 1860 on his return to Shesheke and Linyati with his Makolo carriers he journeyed up the Zambezi, with his brother and Dr. Kirk, to the Zongwe river and then followed the course of that stream up to the plateau near Thabacheu, "the white mountain" now known to the natives as Simwami or Chiribwe.[1] On his return he passed farther to the south the Zambezi at Sinamani village some miles above the mouth of the Zongwe river.

F. C. Selous visited Gwembe in 1877 and again in 1888 on journeys into the interior. On both occasions he crossed the Zambezi at Wankie's village and went down stream following the course of the Zambezi from that point.[2] In 1880 a party of Jesuits under the leadership of Fr. Teroeder visited Mwembas village on the north bank of the Zambezi. Teroeder died there of fever and the party after very ill treatment at the hands of Mwemba returned again to the south.

The next recorded visitors are Major A. St. H. Gibbons in 1898 and Captains Quicke and Hamilton in 1899. This party surveyed the Zambezi down stream from the Devil's Gorge at the mouth of the Gwaai river. The first party of B.S.A. Police had already crossed the Zambezi in 1898 at Walker's Drift and had established posts at Monze and Kalomo on the high plateau to the north of the Gwembe valley.

The elevation of the floor of the Gwembe valley is from 1500 to 2000 feet above sea-level. The escarpment on the northern border rises from 2000 to 3000–3500 feet at its summit. The floor of the valley is intersected by numerous ranges of rocky hills, and several fair-sized flood rivers flow across it and into the Zambezi. Between the rivers are clay flats covered with mopane bush. Probably more than half the area of Gwembe is mopane flat. The rest of the vegetation is mixed but there is a great deal of thorn bush and a fair sprinkling of euphobia trees. Whenever there is a good supply of water large trees such as the *musigili* (*Tammerus indica*) flourish. On the whole the vegetation is much more tropical than in other parts of Rhodesia. Palms and baobabs are common.

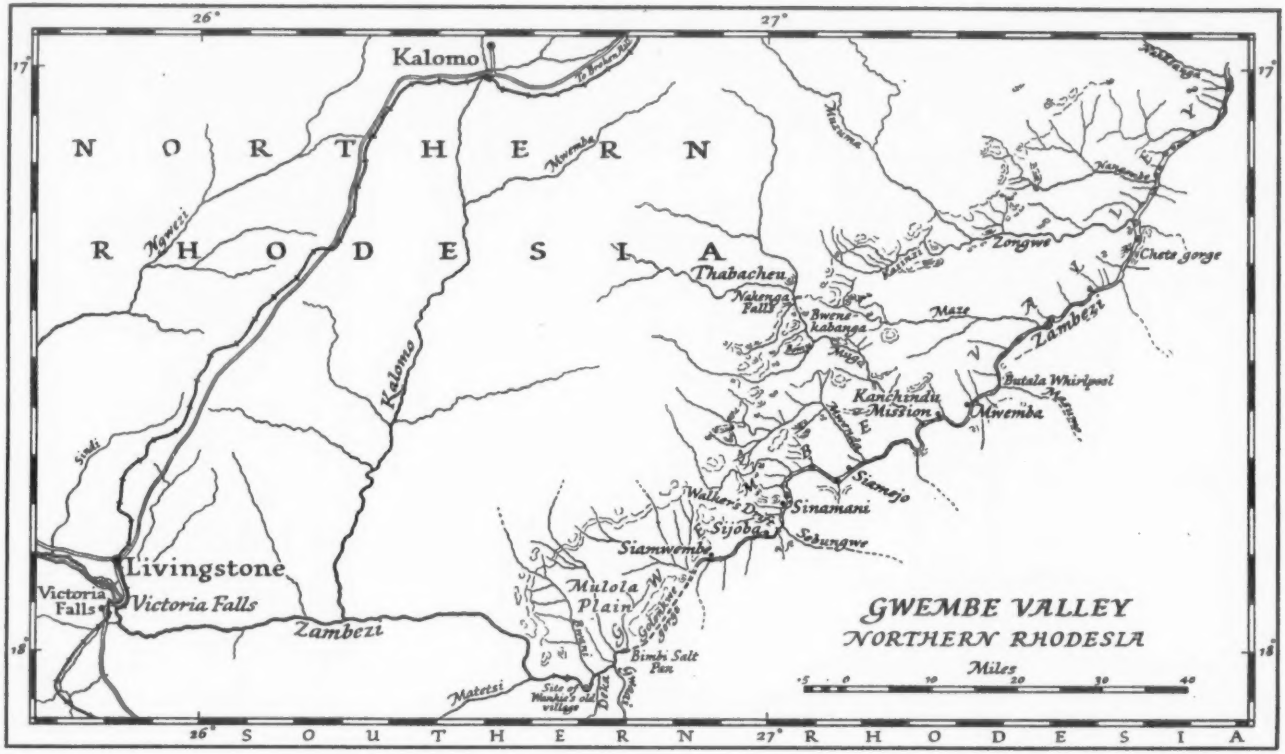
The rainy season is from November to February or March, but as a rule heavy rains cease in February. There are no very accurate or extensive meteorological data, but it seems likely that the rainfall is on the decrease and that possibly it increases and decreases over a cycle of years. Nowadays only 10 or 12 inches of rain falls during the season, while the rest of the country to the north gets anything from 25 inches upwards.

The temperature is high. In the cold months, May, June, and July, the thermometer falls at night to about 40°. In the hot season the day shade temperature mounts to well over 100°, and the damp heat near the Zambezi is very trying indeed. The hot season lasts from September till April.

The escarpment on the Southern Rhodesia side is not nearly so considerable as on the Northern Rhodesia side of the river. It is also worth noting that the escarpment on the east side of the Luangwa, one of the Zambezi's largest tributaries, is as a rule negligible compared with that on its west side.

[1] See D. Livingstone, 'Missionary travels,' p. 548; D. and C. Livingstone, 'The Zambezi and its tributaries,' pp. 227–228.

[2] F. C. Selous, 'A hunter's wanderings in Africa,' 1890, chs. XV and XVI; 'Travel and adventure in South East Africa,' 1893, ch. X.


26°
27°
17°
18°
Kalomo
NORTHERN
RHODESIA
Ngwezi
Mumbwa
Kalomo
Sindi
Livingstone
Victoria Falls
Victoria Falls
Zambezi
Matetsi
Site of Wankie's old village
Dete
Bimbi Salt Pan
Mulola Plain
Siamwemba
Sijoba
Walker's Drift
Sinamani
Siamojo
Sebungwe
Kanchindu Mission
Mwemba
Batoka Whirlpool
Mazoe
Zambezi
Bwenkabanga
Nakonga Falls
Thabacheu
Zongwe
Chete gorge
GWEMBE VALLEY
NORTHERN RHODESIA
Miles
·5 0 10 20 30 40
SOUTHERN RHODESIA

There are a number of waterfalls on the rivers that flow over the escarpment, but as few of the latter are flowing all the year round the various falls cannot be properly appreciated except during the wet season. They are anything up to 100 feet in height. Most of the large tributaries are flowing up to July or August, but after that time running water is only to be found in the hills, though excellent water is locked up in almost all the sandy river beds in the valley itself. Two of the rivers form very fertile deltas at their confluences with the Zambezi. January to June is high water for the Zambezi and the maximum flood height is reached in May, but there are no proper records. From what I have seen the rise of the river is anything from 15 to 20 feet. Several quite considerable islands are submerged at high water.

Hot springs are to be found in several places near the Zambezi; most of those I have seen are at about blood heat, but one reaches boiling-point and behaves like a tiny geyser, shooting up to a height of about 9 inches during the dry weather but higher in the rains.

The river itself varies in width from about 100 yards at the Butala whirlpool to more than 700 yards near the mouth of the Zongwe river and at several places below that point. The larger distances were measured across the river with a box sextant. These measurements were made when the river was almost at its lowest level, but owing to the steepness of the banks they would not be much increased in times of flood.

The dry season current I timed several times and always made it about 5 miles per hour. I never measured it during the rains, but it did not appear to be flowing very much faster.

The Mulola flats or plain are a small extension of the main Gwembe valley which lies roughly between the Deka and the Gwaai rivers but on the northern bank of the river. They are also upstream from the Golonkwe gorge which was first recorded by Livingstone in 1860 [1] and was called the Devil's Gorge by Major Gibbons in 1899. It is said to be an awesome place, and natives describe the sides of the river as precipitous at that point and say it is impossible to walk along the water's edge. Comparatively few Europeans ever go there and I did not myself get to it. When I visited the Mulola plain I came down over the hills from the north, and after travelling along the Zambezi I turned north-east and went over a low pass through the hills into Gwembe. I intended to return and work up the river from Sijoba to Golonkwe, but the opportunity never occurred.

Most of the Mulola plain is uninhabited except for a few villages under the mountains along its northern edge, although the southern bank of the Zambezi supports a fair population. The Zambezi at this point reaches the most southerly part of its course, 18° south, except for a few miles at the mouth of the river in Portuguese East Africa. This point is also the old site of Wankie's village. Wankie is the headman who gave his name to Wankie colliery in Southern Rhodesia 31 miles away, and it was here that Selous crossed the Zambezi in 1877 and 1888. A Jesuit mission has opened across the Zambezi, and a motor road runs from there to the railway. A few miles below the site of Wankie's old village are salt springs known as Bimbi. They are of several acres in extent and a haunt of wild game.

[1] D. and C. Livingstone, 'The Zambezi and its tributaries,' p. 313.

THE LOPO HOMEM MAP ONCE MORE

F. A. KAMMERER

THE results of M. Destombes' theory, as set out in his article published in the *Journal* for November 1937, are that the Lopo Homem world map of 1519 forms part of the Miller Atlas; that this Atlas should be dated 1519 and not, as previously, 1516 or 1517; and that it should be attributed to Homem, and not to the Reinels. I believe that M. Destombes' argument is to a considerable extent valid, and I propose to establish here the accuracy of his first two conclusions, but to show that there is little likelihood of his third conclusion being true.

In my work 'La Mer Rouge,' volume II, I reproduced most of the sheets of the Miller Atlas in colour, and, in black, the Lopo Homem map. Without committing myself on the authenticity of a document which I had not personally examined, I summarized the points at issue, and showed the resemblance it bore to a sheet in the Miller Atlas, that of the Malay archipelago.

M. Destombes is right in saying that one of the two sheets missing from the Miller Atlas is quite likely to be the Homem map. By its shape and general character, it would fit normally into the Atlas, and form the logical opening, as it is a general map. The resemblance between the semi-gothic characters of the title in the first verso of the Homem map and those of the numerous framed legends of the Atlas excludes the possibility of the former being a forgery. As to the identity of the colours, affirmed by M. Destombes, I am unable to judge. I had concluded that if the Homem map was a forgery, the forger was exceedingly clever, and possessed a profound knowledge of contemporary cartography.

I cannot however agree with M. Destombes that an examination of the outlines shows that the Homem map formed an integral part of the Atlas. He considers that the drawing of the coasts of Northern Europe, the sea of the Moluccas, and the China sea is the same in both documents. I agree fully as regards the sea of the Moluccas, and partially as regards the China sea. For the rest, I prefer to reverse M. Destombes' reasoning and to attempt to discover how, despite the serious divergences between the outlines, the Homem map may have formed part of the Miller Atlas without the whole having been the work of one cartographer.

If we first compare the outlines, it is clear from the north-west Europe sheet of the Miller Atlas, reproduced with M. Destombes' article, that the outline of the Homem map is different, though perhaps related. The outlines of the British Isles, the Norwegian coast, and the Baltic are far from identical.

It is not possible to compare the representations of Africa, as the Central and South African sheet is missing from the Miller Atlas. Madagascar is however very characteristic in the Atlas, and is worth attention. The approximate coast-line was revealed by Portuguese navigators from 1500 onwards. On all portolans earlier than this Atlas, the outline is pure fantasy. In the Atlas however the shape displays a standard which was not surpassed for two centuries, and which had already served as a model for the Reinel charts of 1517 and 1520 at Munich. The shape in the Homem map is much inferior.

The Mediterranean outline is also very poor, in my opinion poorer than the old Catalan and Italian portolans, as it also is on the Mediterranean portolan of 1505, attributed to the Reinels, in the Bibliothèque Nationale (Ge. AA 640).

India, it is true, is better proportioned on the Homem map. The Malay peninsula ends in a point, but, in the Atlas, in a knob. Though the conceptions of the two maps are distinct, they are both equally inexact, totally ignoring the Gulf of Siam. A considerable divergence in the latitudes should also be noted. In the Atlas the extremity of the peninsula is approximately correct in about 2° N.; in the Homem it is prolonged almost to the parallel of Mozambique, an error of over 15°, common to maps prior to the Portuguese arrival at Malacca in 1511. As for the 'Chinnarum magnus golfus,' the two maps are very similar, without being identical; in the Miller Atlas it is much more closed. A common source is revealed in the north–south–trend of the eastern shore of the gulf, a shore which has no existence in reality. (This sheet in the Miller Atlas I do not consider to be the work of the Reinels.) The eastern shore on the Homem map is continued southwards and westwards to South America, to form a vast closed ocean. This is a reminiscence of classical geography, but in Ptolemy's maps the Indian Ocean is formed by the prolongation of the coast below Gardafui eastwards to the Malay peninsula. Thus the two ideas of a closed ocean are altogether different, that of the Homem map being in my opinion its principal claim to originality. One cannot assert that this idea was not reproduced in the Miller Atlas, but it is at least unlikely, and there is no other existing chart which embodies it.

The sole region where a true identity between the two maps can be established is the East Indian archipelago with Sumatra, Java, and two large islands farther east. Sumatra is remarkable, for the period, on both maps. The other three islands, on the contrary, are oriented in a fashion as inaccurate as it is characteristic. This cannot be a coincidence; the draughtsman of one had knowledge of the other.

As to the resemblance which has been pointed out between the Homem map and the Piri Reis chart of 1513, this is quite general and disputable. Both maps certainly carry the Brazilian coast-line without a break to a southern continent closing the Atlantic on the south, while the oldest globe of Schöner (1515) already shows a strait between South America and the supposed southern continent. But the discovery of the Strait of Magellan was after 1519, and was only known in Europe after the return of the *Victoria* in 1522, so that Homem's outline of these regions was entirely suppositious. Geographical theorists reasoned from the analogy of an open sea south of the Cape of Good Hope that a passage to the Indies would be found to the south of South America, and they chanced to be right. If the South American coast as drawn by Piri Reis, from Portuguese charts as he himself admits, shows no signs of a strait, the drawing of Homem on the contrary has in the approximate latitude of the Strait of Magellan the mouth of a large river or strait.

There are other divergences between the Homem map and the Miller Atlas, notably the method of representing the sea in the tropics. Homem covers it with horizontal hachures, carelessly done if compared with the wonderful illumination of the Miller Atlas, from which these hachures are absent. The peculiarity of these hachures is increased by the fact that they

are omitted on the northern and southern seas. They are found on no other chart of the period. This style of horizontal hachure was widespread among students at the end of the nineteenth century, at least in France, and this causes hesitation in accepting the complete authenticity of the Homem map. A technical examination of the ink and colours of these hachures would alone elucidate this matter. They suggest, at least, retouching, not of the outline, but of the general appearance. They may be the work of a nineteenth-century possessor, but they are not sufficient to disprove the authenticity of the Homem map.

If one accepts its authenticity, it remains to be decided whether the map can have formed part of the Atlas and whether it is by the same cartographer. The dissimilarity of the outlines is an *a priori* argument against the inclusion of the map in the Atlas. To our ideas, it is strange that a cartographer, having drawn the world on several sheets, should compose what we call a "carte d'assemblage" with an outline at variance with that on the larger scale sheets, although examples exist of this contradiction. The most typical is supplied by the Caneiro map of 1502. In the centre of Africa is placed a circle containing a small map of the continent, with an outline quite different from that of the larger representation. This divergence has never been satisfactorily explained. But there is no need to invoke this reasoning. Up to the present the experts have agreed that the Miller Atlas forms a unit, but it loses this character if it is admitted that the Homem map has been incorporated in it, and that the sheet of the China gulf is another addition. The Atlas then becomes a composite collection, and the internal differences are explained. Even in its present composition the Atlas, homogeneous as regards illumination and calligraphy, is not so as regards the contents, since, though the greater part of the maps are pilot charts based upon direct and accurate information, one of them, as we have seen, displays theoretical geography, and contains no accurate data, and no names of existing rivers or mountains. This China gulf, although from the same *atelier*, is no more a part of the series than is the Homem map.

Let us see if the outline of the Homem map is by the same hand as the Paris sheets. This leads us to inquire into the manner in which portolans were put together. The scientific portion, that is to say, the outline at least of the *padrones*, the type incorporating the data resulting from exploration, was the work of pilots or the draughtsmen to whom they handed over their sketches on their return. These skeleton charts were re-drawn on large parchments which if destined for important personages or wealthy amateurs, were passed on to the illuminator or miniaturist. The latter was not always identical with the person charged with inscribing the legends, or *lettre*. The miniaturist and calligrapher no doubt worked in a studio on all kinds of documents, emanating from different pilots and explorers. Thus identity of miniaturist and calligrapher of the two documents in no way implies identity of the author of the outlines. But for the majority of the maps attributed to the Reinels up to and including the sheets of the Miller Atlas, the same miniaturist and calligrapher are involved, and one is also right in concluding in the majority of cases, that the outlines are by the same hand.

Can one apply the same reasoning to the Homem map? Certainly not.

Even if the colours used to paint it and the Miller Atlas are the same, they have not been employed in the same manner. The sheets of the Atlas have splendid wind-roses, a superabundance of magnificent Portuguese vessels sailing the seas with billowing sails, realistic paintings from life, hunting scenes, natives chasing wild animals, birds. There are compass-lines intersecting intricately, sub-division into climates, and scales. The Homem map, which it is true is a small-scale *carte d'ensemble*, has none of these. Its outline is not overloaded with detail, but the sea is hachured. If the calligrapher who wrote the title also wrote the names on the sheets of the Miller Atlas, he did not write those on the map itself.

The following are the conclusions I have reached. The Miller Atlas is a factitive collection, and does not necessarily imply unity of authorship or of geographical outlook. The Homem map once formed part of the Atlas. It furnishes us with the date 1519 as a *terminus ad quem*, that is, the sheets of the Atlas are anterior to it, perhaps only very little. Lopo Homem is certainly the author of the world map signed by him and dated 1519, but he is not the author of the sheets of the Atlas. Homem was acquainted with certain of the sheets of the Atlas, but not with all, or perhaps he discarded the outlines of some. There is nothing to justify the Reinels being deprived of the authorship of the Miller Atlas sheets. If the date 1516 or 1517 must be rejected, it cannot be later than 1519. The Gulf of China sheet has, like the Homem map, been incorporated in the Atlas, and is not the work of Homem or the Reinels. Geographically without value, it antedates them by at least ten, or perhaps twenty, years. The calligrapher of the Atlas sheets also wrote the title on the first verso of the Homem map. The miniaturist of the Homem map is distinct from the artist of the Atlas sheets. The title on the Homem map applies to it alone, and not to the remainder of the Atlas.

THE TEES-SIDE IRON AND STEEL INDUSTRY

J. T. GLEAVE

A CENTURY ago, Tees-side was "unknown, bare, undeveloped, and speculative"; to-day, it is the chief steel-producing centre in the United Kingdom. The steel industry on Tees-side grew up in a night, as it were, for it had no traditions in iron making as had South Wales, where the modern steel works trace their origin to the days when local ores and timber supplies were the basis of a prosperous industry. Tees-side was an entirely new departure in that it was the first region to exploit the Jurassic ores on a large scale, whereby it was able to surpass such districts as Staffordshire and Scotland, whose prosperity was based on the Coal Measures ores. For the first time also, blast furnaces were not erected in close proximity to the pit head, but at a point where coal and ore could be readily assembled. Tees-side has always shown itself readily capable of adapting itself to new conditions, and even to-day, when local supplies of ore are nearing exhaustion, the region can maintain its predominance, because of the ease with which foreign ores can be imported to the works situated along the river bank.

One may distinguish three main periods in the evolution of the industry: before 1850, when Tees-side possessed small works for the production of iron goods, situated there because of the facilities for the assembly of imported pig-iron and of coals from the Durham coalfield; 1850–80, when iron production was unrivalled by steel; and after 1880, when steel manufacture ousted that of iron, although pig-iron production remained as important. One might distinguish a fourth period by comparing the condition of the industry after the war with its pre-war position.

Ironworks first came to Tees-side because it possessed a site pre-eminently suitable for the assembly of raw materials. In 1830 the Stockton and Darlington Railway had been extended from Stockton to Middlesbrough, and the promoters of the line had hoped to build up an industrial estate at its terminus. The first ironworks were established in 1841: they were attracted by the reasonable shipping facilities, the easy import of Scottish pig-iron from Fife, which in that year was only 35*s*. a ton, and the ready supply of cheap coals from the Durham coalfield, by way of the Stockton and Darlington Railway. There was a ready market at hand among the smiths of Cleveland, and later, a further market was provided when the railway company established a branch engineering shop at the terminus.

Actually, economic factors played as great a part as geographical factors in the establishment of industry at Middlesbrough, and the boom which prevailed in the iron industry about 1845 proved that the site was not as economical as it had at first appeared. The big demand for railway building had sent the price of Scottish pig up to £6 a ton. Accordingly, Bolckow and Vaughan, the Middlesbrough manufacturers, sought to make their own pigs from Coal Measures ore, which they hoped to find in the Durham coalfield at Witton Park. They were disillusioned, and in 1846 they placed an order for 3600 tons of Cleveland ironstone with the Grosmont mine owners.

The Middlesbrough wharves received the ore, which was carried by the Stockton and Darlington Railway to Witton Park to be smelted. The returned pig was used in the Middlesbrough rolling mills. One might have thought that it would have been cheaper to have established furnaces at Middlesbrough, but at that time the Cleveland ore from the Whitby district had not fully established itself, and was merely used as a "mixer" at Witton Park.

The discovery and the utilization of the main seam of ironstone in the Eston Hills in 1850 entirely revolutionized the iron industry in the north of England, and before long the Coal Measures iron districts found it most difficult to compete with an area which had coal, plentiful ore, and limestone all within short distance, and also good river facilities for export.

The ironstone of the Eston Hills became the basis of a great industry. Actually, Cleveland ironstone of a similar character had already been known and used as early as 1800, when it was obtained in nodules collected on the beach between Saltburn and Scarborough. But it was only with difficulty that it forced its way into the market in the face of the Coal Measures ores, especially those of Scotland. When the ore began to be worked at Eston however its qualities were already noted and tested, and more fortunate still, the ironmasters who worked it at Eston had already had some years of experience with it at the Witton Park blast furnaces.

The ore, as it appears at Eston and Upleatham, is at its richest, and lies in the upper part of the Middle Lias. Bewick, one of the earliest of the geologists to study this region, had noted before 1850 how in the Kettleness and Boulby region and as far north as Guisborough the aggregate thickness was great, but that the deposits were much divided and separated by the intervention of shale. At Eston however the various ironstone strata unite to form one mass with a thickness of 16 feet of ironstone. The ore discovered in the rich main seam at Eston contained approximately 28 per cent. iron, 55 per cent. phosphorus, and 11·87 per cent. silica. The siliceous nature of the ore rendered necessary the use of large quantities of limestone for fluxing, but this was easily obtained from the quarries in Weardale, which were already connected by rail with Tees-side. The amount of ore mined rapidly increased till by 1880 Cleveland had attained the annual output of 6,486,000 tons, which was almost 36 per cent. of the total ore output for the whole country.

In addition to the ore and limestone already mentioned coal was easily obtained from the area of good coking coals in the south-west Durham coalfield 30 miles away. On the assumption that to produce 140 tons of pig-iron weekly each furnace required 600 tons of coal, the forty furnaces on Tees-side in 1855 would consume 1,248,000 tons of coal a year. At the time of the opening of the iron mines, Middlesbrough was actually exporting over 1,000,000 tons of coal per annum.

River facilities were also good, especially after 1852, when the Tees Conservancy Commissioners were appointed. Before 1850 the river had been used for the import of Scottish pig; after 1850 it was used for the export of ore, often at the rate of 1000 tons a day, to Scotland.

The abundance of iron ore naturally led to the erection of blast furnaces in close proximity. The expansion was enormous, for, whereas in 1851 Tees-

side had three blast furnaces, in 1861 there were fifty, and in 1871, one hundred and twenty-two furnaces. The distribution of the furnaces is interesting. At first they were established on the flat land between the river and the hills which supplied the ore. The furnaces erected at Eston were only 2 to 3 miles from the mines, there being a private line down the incline from the hills into the works. But the railway was the determining factor, and furnaces were erected on both sides of it, from Middlesbrough to the Eston works. The superior importance of the railway over the river at that time was shown by the fact that many furnaces were established inland, in relation to the line which provided the coals. Such were the works at Norton and Carlton, on the northern coal line leading to Port Clarence (see Fig. 1). At the same time blast furnaces were early erected at Port Clarence, a port of coal shipment, on the north bank of the river. The ironstone was at first brought to Cargo Fleet from the mines at Normanby, and then carried across the river in keels. Besides the nearness to the railway, the sites of these works were probably determined to a large extent by the cheapness of the land, whilst those at Dinsdale had the advantage of being near to the Darlington forges.

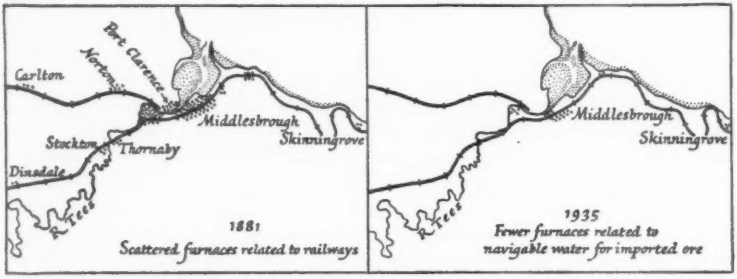


Fig. 1. Distribution of blast furnaces in 1881 and 1935

The presence of cheap and abundant pig-iron naturally attracted works for the manufacture of iron, and although much pig-iron was exported—in 1874 out of the 2,000,000 tons of pig-iron produced 25 per cent. was exported—yet there was a considerable local production of iron. In the same year Tees-side produced 583,844 tons of finished iron.

The main period for the establishment of puddling furnaces for making iron was after 1860. In 1864 there were only 188 puddling furnaces with a capacity of 100,000 tons of finished iron yearly. In 1872 there were 1000 furnaces, stretching from Stockton to South Bank, producing over 440,000 tons of finished iron. In the distribution of the puddling furnaces, one would expect them to be closely related to the blast furnaces, but this was not entirely the case. Of the 995 in existence in 1871, 456 were in the Middlesbrough district, 384 in Stockton, and 165 in Hartlepool. Indeed, in 1888 Stockton and Thornaby possessed more ironworks than Middlesbrough, for in that year the former had fifteen ironworks, while the latter only had twelve. One reason for this greater development at Stockton was, perhaps, that it possessed more available land for works. It was also nearer to the coal supplies. The main explanation however may lie in the fact that it was

the natural manufacturing centre for the several blast furnaces in the neighbourhood, especially those at Norton, Carlton, and Thornaby. The river and wharf facilities were a further advantage possessed by Stockton and Thornaby.

In addition to the establishment of puddling furnaces, the cheap pig-iron also attracted foundries, at such convenient centres as Middlesbrough, Stockton, Haverton Hill, and Port Clarence. One firm alone was making about 3,000,000 feet of iron tubes a year in 1873.

The chief production of the ironworks was rails, which were in great demand both at home and abroad; but the introduction of steel was to deal a death blow to the industry, for a steel rail will last three times as long as an iron one. For a long time however the high cost of steel kept the market open for iron. In 1864 the price of railway bars from steel was £17 per ton, whereas iron rails were only £7 a ton. In that same year the mean selling price of Cleveland iron was £2 17*s*., and haematite pig was a little under £4. Thus there was a difference between crude metal and finished rail of £4 3*s*. for the iron and £13 10*s*. for the steel. The ironworker thought he had little to fear, and on Tees-side, as indeed throughout the whole of the country, there was a great expansion between 1860 and 1870. But whereas in 1871 there were almost a thousand furnaces on Tees-side, in 1878 there were only 446 (165 at Middlesbrough and 248 at Stockton). The iron rails were gradually ousted by steel, and whereas in 1872 Tees-side was making 299,074 tons of rails, the figure had fallen by 1879 to 6,768 tons. The loss of trade in rails was replaced to some extent by the manufacture of ships' angles and plates, but they were far from being sufficient to make up the loss. Thus, whereas in 1872 Tees-side accounted for 640,251 tons of manufactured iron, in 1879 her production was only 290,891 tons. The following figures are informative as to the state of the industry:

Production of manufactured iron in thousands of tons

	Rails	%	*Plates*	%	*Bars*	%	*Angles*	%	*Total*
1872 ..	299	48	178	30	75	14	58	8	610
1873 ..	324	51	165	28	79	14	44	7	612
1874 ..	265	41	178	32	91	19	49	8	583
1875 ..	246	44	173	28	101	20	41	8	561
1876 ..	108	18	172	44	88	23	52	15	420
1877 ..	37	10	214	53	77	20	67	17	395
1878 ..	22	2	234	59	78	17	87	22	421
1879 ..	7	3	174	57	61	23	49	17	291

Nothing could stem the advance of steel, and Tees-side had either to adapt itself to its production or disappear as an industrial region as quickly as it had arisen. The region did not possess haematite, but this could be obtained direct by rail from Cumberland and by ship from Spain. The works which were situated in relation to the railway now found the river to be of greater importance, and they were fortunate in being only a very short distance from the wharves.

The first steel works were commenced on Tees-side in 1876, and by 1877 three Bessemer furnaces were erected, and steel rails were rolled. In 1879 however the Gilchrist-Thomas experiment was tried at Middlesbrough, and its success led to the erection of more furnaces. The amount of steel produced by these two methods can be seen from the fact that of the 3600 tons of rails made in 1881 per week, 1000 tons were from Cleveland steel. Thus at first the Bessemer process was of the greatest importance, and in one month alone, in the same year, 4200 tons of blooms were made, or more than the whole Bessemer production of Great Britain a dozen years before. The Bessemer furnace however was soon replaced by the open-hearth furnace. The utilization of local phosphoric ores did not render unnecessary the import of foreign ores, and in 1900 Tees-side was importing 1,250,840 tons of ore, whereas in 1885 the imports had only been 349,868 tons.

Throughout this period some iron goods continued to be manufactured, as the following figures show:

	Iron goods	*Steel*
1890	265,675 tons	240,596 tons
1910	168,208 ,,	681,593 ,,

The last puddling furnace was blown out in 1922.

The Tees-side iron and steel industry has not yet regained its pre-war prosperity. Actually pre-war steel production has been exceeded, but local ore output and pig-iron production have declined considerably. The implications of this are revealed in the trade of Middlesbrough, which has declined considerably since the war. Middlesbrough is a port which deals chiefly in iron and steel, and therefore its trade figures may be taken as indicative of the recent trend.

Value of exports in millions of pounds sterling

1907–10 (average)	£8·2
1916	£10·25
1931	£5·2
1935	£5·8

The explanation of these changes can best be made by a survey of the individual fields of production: ore, pig-iron, and steel.

Ironstone production.—The extent to which the ironstone output has declined can best be seen from the following figures:

1883	6,765,055 tons
1913	5,940,965 ,,
1929	2,673,900 ,,
1933	1,000,000 ,,

At the same time, whereas there were about twenty mines working in the area in 1917, there are only four to eight to-day.

The main reason for the decline is that the best mines are beginning to

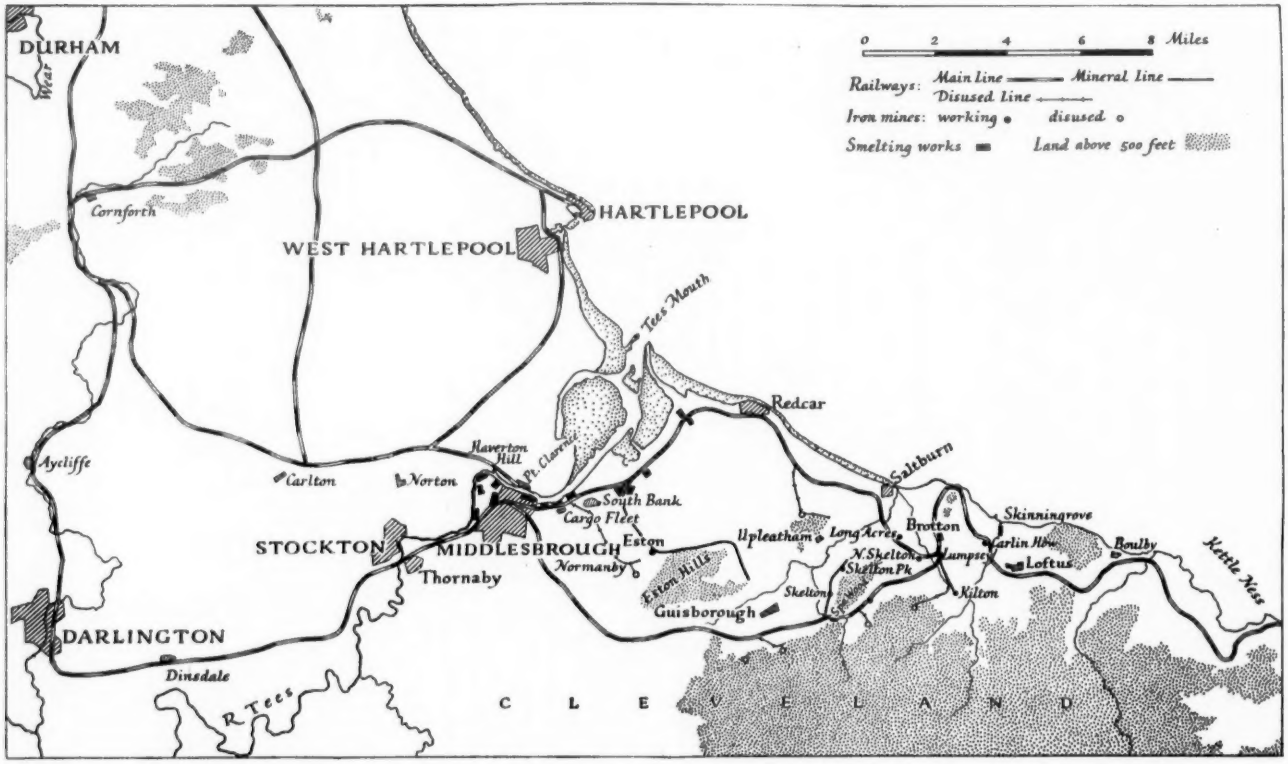


Fig. 2. Distribution of iron mines in Cleveland; those along the escarpment are almost worked out

be worked out. All of the mines along the Eston and Upleatham outliers have been abandoned since the war, with the sole exception of the Eston mine itself (see Fig. 2). The same applies to the escarpment overlooking the Vale of Guisborough. These mines were worked first by quarrying and later by adit mining, but as one progresses towards the south the ore has to be obtained by sinking pits, excepting where the plateau is cut by a deep valley as at Loftus, thus rendering adit mining possible. North Skelton pit is 720 feet deep, and several have been sunk to well over 300 feet. The necessary resort to pits naturally increases costs; at the same time the ore decreases in thickness southwards. In the direction of the dip, the ironstone is split into two parts by the "Dogger," which increases in thickness as the ironstone diminishes. At Spawood mine a survey showed that within a distance of 1700 yards, there was a variation of the bed from $7\frac{1}{2}$ feet without shale to $6\frac{1}{2}$ feet inclusive of 18 inches shale—a diminution in the thickness of ironstone amounting to 35 per cent. within 2 miles. In addition, in the direction of the dip the stone becomes lower in iron content and higher in silica, thus increasing the factors which militate against profitable working.

Increasing distance from the works to the mines, occasioned by the movement of the iron workings to the south, has also increased railway costs. At the foot of the two escarpments rail communication was easy, but becomes more and more circuitous as one proceeds into the hills. Under such circumstances the two most profitable mines are at Loftus and at Eston. In the former the ore is carried direct from the mine mouth over a very short distance by aerial ropeway to the blast furnaces, whilst at the latter the ore is carried by private line from the hillside to the works over a distance of only 2 or 3 miles. In the effort to reduce rail costs ore from the Carlin How pit is carried underground to be brought up west of Brotton at the Lumpsey mine, which is some distance nearer to the steel works. In a somewhat similar manner, ore from a pit on the Guisborough side of the Eston outlier is brought round by private line to meet the Eston line. To meet the problem of increased costs, the railway company has offered rebates, but a revival in production is not forthcoming.

The pits to the south were worked profitably before the war, and heavy railway charges were met. It has been shown that the supplies decrease southwards, but this alone does not explain the decline. One must bear in mind that since the war newer ironstone areas have been opened up, with which Cleveland cannot possibly compete, and that is perhaps the main reason for the decline in Cleveland production. The quarries of the new Rutland and Northamptonshire fields can be worked much more cheaply than the adit mines or pits of Cleveland. The following figures show that the former fields can produce a greater output with a greater iron content and with less labour.

1935	*Production*	*% Iron content*	*Persons employed*
Cleveland	1,640,093 tons	28	2504
Northants, S. Lincs., Rut.	4,311,286 „	32	1776
North Lincs.	2,435,745 „	22	555

The different conditions of working and the cheaper costs are also seen in the following prices of the ores at the mine in these areas:

	s.	*d.*	
Cleveland	5	11	per ton
S. Lincs.	3	0	,,
N. Lincs.	2	6	,,

As a result of this great difference in price, the Lias ores of Cleveland have lost a great deal to those of the Inferior Oolite, as the following figures show:

Percentage output of U.K. production

	Cleveland	*Northants., Rut., S. Lincs.*
1918	30·2 per cent.	23·1 per cent.
1932	13·4 ,,	38·33 ,,

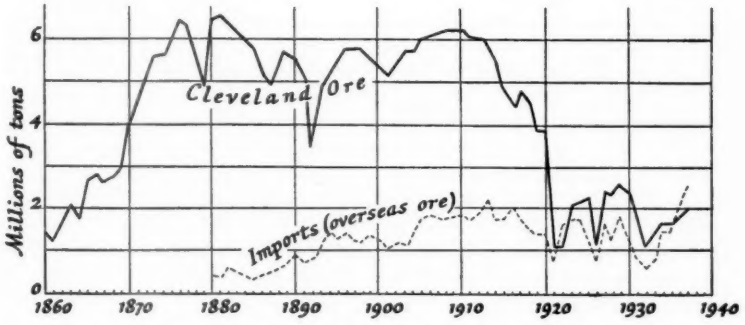


Fig. 3. Graph showing production of Cleveland ores and imports

But the decline in output is not only due to the fact that Tees-side cannot compete with the newer areas: there is less output because it is actually cheaper to import foreign ores. The use of foreign ores means a saving in fuel costs. The iron content of the Cleveland ore is low (about 28 per cent.), whereas that of some of the Swedish ores exceeds 60 per cent., and of some of the Spanish ores 50 per cent. Accordingly, other things being equal, there is a substantial saving in fuel if richer ores are used. For this reason in several recent years imports of foreign ores have exceeded local production (see Fig. 3). Africa, Norway, Spain, and Sweden are the chief suppliers, although supplies from Norway have declined since the war. The following figures show the percentages of ore from different sources used on Tees-side. The figures for 1936 are those for the Dorman, Long Steel Works at South Bank, which give a fairly true indication of the whole region. The 1919 figures include the whole of Tees-side.

	1919	1936
Cleveland	77 per cent.	57 per cent.
Spain	13 ,,	3·0 ,,
Africa	7·0 ,,	30 ,,
Norway	3·0 ,,	—
Sweden	—	10 ,,

In addition to the foreign imports, ores are received from the Northamptonshire field to the extent of 312,000 tons a year; it is interesting to note that Dorman, Long, and the Cargo Fleet works have mines in the above area. The Northants supply is scarcely a fifth of the total ore imports from overseas in 1935.

Pig iron production.—The present-day pig-iron production shows a considerable decrease on that of pre-war years. This is revealed by the following figures:

1913	3,869,000 tons		
1929	2,348,500 ,,		
1934	1,638,700 ,,		
1937 ..	(approx.) 2,283,400 ,,	(first six months=1,141,700)	

Thus, although industry is working at its greatest capacity to-day, it is well behind the production of 1913. The decline is further shown by the fact that whereas in 1913 Tees-side accounted for 37·7 per cent. of the pig-iron production of the United Kingdom, in 1933 the proportion was only 24·9 per cent. of the whole. On Tees-side itself this fact is evident in the large number of blast furnaces which have been abandoned or dismantled since the war. Blast furnaces at Port Clarence, Norton, Dinsdale, Carlton, Stockton, and Thornaby, have all been pulled down, so that to-day the furnaces are concentrated chiefly at Middlesbrough and Redcar, where there is the advantage of a river frontage. The following figures show the decrease in the number of blast furnaces:

1881	107	furnaces	blowing
1929	43	,,	,,
1933	18	,,	,,
1937	36	,,	,,

Undoubtedly there is a greater production per furnace to-day than before the war, but that is not sufficient to keep up the production to the pre-war level. Whereas the average make per furnace thirty years ago was 1000 tons per week, to-day 2300 tons have been attained in a week. On the surface it might appear that the reduced pig-iron production is related to the decline in the output of Cleveland ore. It has been shown however that it is often as economical for Tees-side to import foreign ores. The present day imports are about the same as those before the war, and they have not replaced the ore output that Cleveland reached before the war.

The decline may to some extent be due to the increased use of molten metal for steel making; if this is so there will be large amounts of ore which are not made into actual pigs. This indeed is a likely explanation, for although

this process was practised before the war it is even more used to-day, especially on account of the rationalization that has overtaken the industry. In the present state of the industry, the blast furnaces that have been maintained are those which are only a short distance from the steel works. The increased use of scrap in steel making may also explain the decline in pig-iron production. There is no mention of scrap whatsoever in the trade figures of 1910, whereas in 1930 11,092 tons were imported, and in 1930 the enormous total of 52,885 tons was received in the Tees.

Undoubtedly, Northamptonshire, which specializes in pig-iron production of superior quality for forge and foundry, has captured the markets of Tees-side, especially in the Midlands. At the same time, there may have been a decrease in the demand for the above qualities of iron, and in support of this it may be said that the Northamptonshire production has also declined since the war.

The production for the whole country has declined to such an extent that the entire United Kingdom was not producing as much pig-iron in 1933 as Tees-side alone in 1913. In the light of this fact it would appear that the whole country has lost the foreign market which it had before the war. This is actually the case with regard to Tees-side, and is the chief explanation of Tees-side's reduced production. The following figures are indicative in this respect:

Exports of pig-iron

1910	1,047,164 tons
1930	177,157 ,,
1936	69,048 ,,

And of the 1936 exports, 33,060 tons went coastwise chiefly to Scotland.

Steel production.—The steel industry has maintained itself at a high level of production in the post-war years, as is shown by the following figures:

1913	2,031,100 tons	
1927	2,236,300 ,,	
1935	2,050,400 ,,	
1937	1,386,000 ,,	(*i.e.* for first six months)

Tees-side production of steel is now the greatest in the whole of the United Kingdom. This supreme position has been obtained as a result of the combination of many geographical advantages. At the same time, whilst the new ironfields have been rivals in pig-iron production, they have not till recently been rivals in the manufacture of steel. Few sites are within such close distance of the necessary raw materials as Tees-side, a factor of great importance when considering transport costs. Local ore supplies from the Cleveland Hills are on the decline, but foreign ores can be easily imported at the many private wharves adjoining the works. The coal supplies of the Durham coalfield are at hand, and are capable of meeting the demands of the works. On the average 100,000 tons of coal are brought weekly from the Durham fields. In addition, about 3000 tons a week are obtained from South Yorkshire. The limestone quarries of Weardale and Wensleydale are only 30 to 40

miles from Tees-side. The former are the greatest producers with an average of 7700 tons a week. Barton and Forcett together produce 2850 tons a week, while Leyburn and Wensley provide Tees-side with 3700 tons a week. Dolomite is also abundantly obtained within a short distance of the works, at Aycliffe and Cornforth.

It is perhaps unlikely that many sites in the world have such advantages as Tees-side for the manufacture of steel. Actually Birmingham in the U.S.A. rivals Tees-side in the matter of the assembly of raw materials, for it has ore, coal, and limestone all within a radius of 15 miles of the steel-producing centre, so that transport cost is very slight indeed. But although Birmingham, U.S.A., surpasses Tees-side in this respect, yet it is not so favourably situated for the marketing of its manufactures, or for the import of foreign ores if that were ever necessary, for whereas Birmingham has only land communication, Tees-side has access to the sea as well. At the Middlesbrough docks large vessels can be berthed and there are forty-nine electric cranes, especially for the shipment of steel manufactures. In the matter of water navigation Tees-side is much like the steel works along the sea-front on Chesapeake Bay in Maryland, although they differ in that the latter has to obtain its raw materials over larger distances.

The latter two regions are comparable in that they are both in the midst of a big market. Although Tees-side has nothing but moors to the south of it, yet to the north are large engineering establishments and shipyards. Maryland is near to the great structural steel consuming cities. The Tees-side steel industry also possesses the advantage of not being cramped for space. Wide areas of reclaimed land, adjoining the river, have been as important to the steel works of Tees-side as have the great wastes along the shores of the Great Lakes, upon which great steel plants have been established. Thus, while each steel area in the U.S.A. has its own individual advantages, Tees-side possesses them all within a very short area.

Most of the steel production on Tees-side is by the basic method, as the following figures for ingots produced show:

	Acid	*Basic*
1925	193,000	1,999,000
1935	176,900	1,849,000

Tees-side has been able to maintain its big production because of the large local demand. For its rails there is a large national demand, but its girders and plates are chiefly consumed in the north-east.

Of the many industries dependent on the steel works, the chief is that of constructional engineering for which Tees-side has long been famous. Tees-side has the honour of having made such famous bridges as the Victoria Falls Bridge, and also the Lower Zambezi Bridge, which is $2\frac{1}{2}$ miles in length. The Sydney Harbour Bridge, the largest single-arch span bridge in the world, was also built on Tees-side, whilst only recently the longest bridge in Europe was built by a Middlesbrough firm for the Danish Government.

The shipbuilding industry provides a further market, especially for plates and angles. The yards on Tees-side were responsible for the launching of a tonnage of 154,743 tons in 1913. In 1920 the production was 162,465 tons,

and in 1937 the tonnage launched was 85,523. The Hartlepool yards are supplied to a great extent by their own steel works. But Tees-side does not only supply her own shipyards; there is a greater demand on the Tyne and the Wear, especially on the former since the closing of the Jarrow steel works. Tyneside has only four open-hearth furnaces, compared with the fifty-five on Tees-side; thus, when it is realized that on the average Tees-side only produces 25–30 per cent. of the tonnage launched in the north-east, it can be concluded that the Tees steel works have a large market on the Tyne and Wear. Shipbuilding also leads to a big demand for steel for marine engineering purposes, especially in the Darlington, Middlesbrough and Hartlepool works.

The smaller firms on Tees-side have managed to maintain themselves by specializing in certain types of production. Some concentrate on black and galvanized sheets, others on the manufacture of equipment for blast furnaces and steel plants, while one firm specializes in the making of chilled and grained rolls.

But although the steel works on Tees-side have maintained a high production because of the large local demand, yet foreign trade has declined somewhat, as the following figures show:

1913	.. ..	720,733 tons
1920	.. ..	324,222 ,,
1929	.. ..	753,098 ,,
1936	.. ..	470,311 ,,

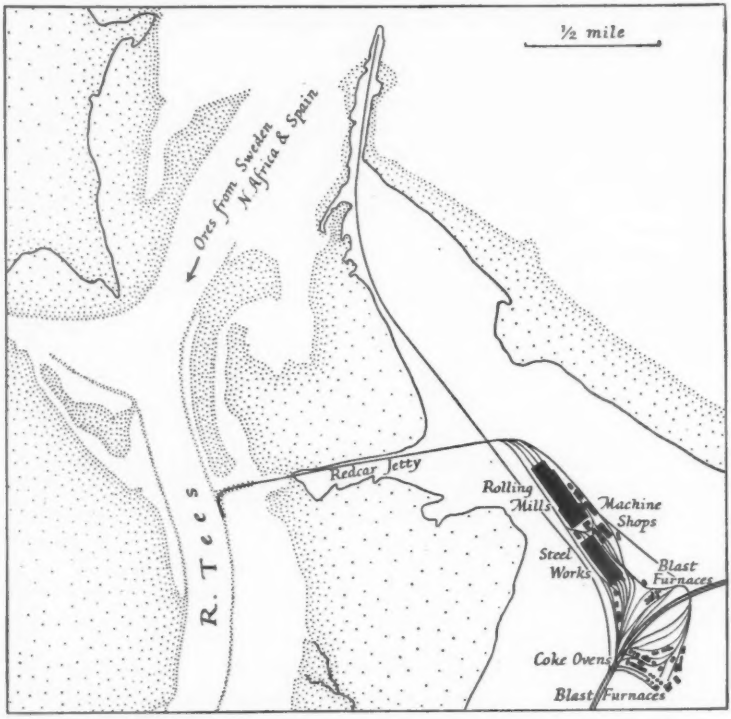
The figures show that whereas the exports were low in the immediate post-war years, they had improved by 1927. The explanation for the decrease is to be found to some extent in the tariff policy of Italy, Japan, China, India, and Australia, and in the cheaper production in other countries. It was actually profitable for Tees-side to import blooms and billets already made up in 1930, when 106,176 tons were imported. In 1936, only 38,325 tons were imported.

Rationalization.—Of recent years there has been a tendency to bring coalfields, ironfields, and limestone quarries all under the one control. One combine, Dorman, Long & Co., Ltd., now owns and operates collieries with an annual output of 4 million tons and ironstone mines with an annual capacity of $2\frac{1}{2}$ million tons. Uneconomic plant has been abandoned and production centred in certain exceedingly favourable places. The main areas of production are now between Middlesbrough and South Bank, where foreign ore can be received at the wharves. At South Bank, blast furnaces, steel works, and coke ovens are all together. A similar concentration is to be seen with regard to the Redcar Works (see Fig. 4), which receive their ore from a jetty that goes well out into the mouth of the river.

A great economy effected by rationalization is the moving of the coke ovens from the collieries to the works. At the collieries gas could only be used uneconomically whereas at the works the surplus gas provides all the fuel necessary for steel making. At the same time it is more economical to operate one large unit than a series of small ones. The South Bank works possess the largest coking plant in England. It uses 20,000 tons of coking coal a week

in producing 13,000 tons of coke and by-products, such as sulphate of ammonia, crude tar, benzol, and disinfectants.

As a result of the concentration of plant, output per furnace and per man has been considerably increased. Thus, the 75 furnaces in operation in 1935 had a greater output than the 125 furnaces which were working in 1913.



Redcar Steelworks: plant concentrated and placed near river mouth

The following figures show the increased production per man.

1923	24,559 employed	68·4 tons per person
1935	22,448 ,,	82·9 ,, ,, ,,

At present Tees-side is Britain's chief steel producer. The question is: how long will this position be maintained? The decline in the total output of ores has been referred to. In Cleveland supplies will only last another sixty years, whereas those of Northants will last at the present rate of production for five hundred years. This fact would have very great importance if Britain were to follow the recent example of Germany and produce more steel from local ores by means of some new process, thus becoming independent of outside supplies.

It might be contended that Tees-side with its plant and skill would in any event retain the industry. But if the new processes demand new plant, then the attraction of Tees-side will be weakened. At any rate a considerable quantity of ore would have to be brought up to the Tees from the Midlands. That being so, it would not be unlikely that the Midlands themselves would become greater producers than Tees-side. The Northampton area is not likely to be a serious rival because of its inland position, and the absence of water navigation would in the long run be a serious handicap, even if self-sufficiency be the immediate programme. The Frodingham area however has coal, ore and limestone all within 20 miles, and also navigable water. At the same time it is as near the European markets as is Tees-side. But Tees-side has the start: it has the necessary skill and experience which will always stand it in good stead, whilst the recent rationalization will undoubtedly increase its efficiency.

GENERAL REFERENCES

Charles Postgate: 'Middlesbrough—its history, environs and trade," 1899.

"The iron, steel and engineering industries of Middlesbrough and district." Visit of Iron and Steel Institute, 1937.

Sir Lowthian Bell: 'Iron trade of the United Kingdom.' Printed by British Iron Trade Association, 1886.

Bewick, J.: 'Geological treatise on the district of Cleveland in N. Yorkshire.' 1861.

Imperial Mineral Resources Bureau. Iron Ore. Part I. United Kingdom, 1922.

"An industrial survey of the N.E. Coast Area" (Made for the Board of Trade by Armstrong College). Newcastle, 1932.

"Works on N.E. Coast of Dorman, Long." *Iron and Coal Trades Review*, July–August 1937.

Statistics from "British Iron and Steel Federation." "Home and Foreign Iron and Steel Industries," 1878–90. "The Iron and Steel Trades," Special Reviews. "Middlesbrough Chambers of Commerce Reports," 1877–1910.

This essay, submitted for the Geographical Essay Prize 1938, *was adjudged by the Council to be worthy of publication.*

The conditions for the competition for 1939 *were announced in the* Journal *for March* 1938, *p.* 290.

NEW MALTESE ORTHOGRAPHY

SINCE Crown Colony Government was resumed in Malta in 1933, English, as the language of the British Empire, and Maltese, as the language of the Maltese people, have become the official languages of Malta, and Maltese has become the principal language of the courts of law. The wider recognition of Maltese made it necessary for the Government to decide which of the several systems of Maltese orthography should be adopted for official use. That of Il-Għaqda tal-Kittieba tal-Malti (The Maltese Writers' Association) was chosen. The system is fully described by Edmund F. Sutcliffe, S.J., in 'A grammar of the Maltese language' (Oxford University Press. London: Humphrey Milford, 1936). It differs in several important respects from the Cremona system previously in use (*R.G.S. Technical Series: No. 2. Alphabets of Foreign Languages. Second Edition.* London, 1933, pp. 75–76). *c* has disappeared, and *ch* is now represented by *ċ*. *q* has been introduced, and *k* and *q* now correspond to the Arabic kaf, ك, and qaf, ق, respectively. Father Sutcliffe claims that "The Maltese [Għaqda] alphabet is very nearly a perfect one. Except for the digraph għ to represent the letter "għajn" [the Arabic 'ain, ع] it has one sign for each sound ; and only one sound is represented by each sign except where assimilation occurs."

A short, official list of place-names in the new orthography has recently been circulated. It shows that the new spelling differs considerably from that on the latest British maps and charts. And, though such prominent names as Valletta, Gozo, Victoria, remain official, a number of less important foreign names have been replaced by Maltese names. The following examples illustrate the differences between the new Maltese and the English alphabets:

Għaqda spelling	*R.G.S.II transliteration*
Birżebbuġa	Birzebbuja
Għajnsielem	'Ainsielem
Għaxaq	'Ashaq
Gżejjer	Gzeiyer
Kirċem	Kirchem
Mġarr	Mjarr
San Lawrenz	San Lawrents
Xagħra	Sha'ra
Żebbuġ	Zebbuj

REGIONAL DIVISIONS IN CATALONIA

LA DIVISIO TERRITORIAL DE CATALUNYA. [Compiled with the assistance of PAU VILA.] *Barcelona: Generalitat de Catalunya (Conselleria d'Economia)*, 1937. 8½×6 *inches; 116 pages; illustrations and maps*

CATALONIA has always been at once the principal entry into the Peninsula from Europe and the last outpost of Castilian influence. No other corner of Spain has known such comings and goings of armies and cultures or so close

a contact with countries overseas. As a unit therefore it had the amorphous elasticity of a buffer zone. Every change in its economic orientation brought readjustment of its political geography, so that its provincial divisions have been singularly varied. The Republican Government of Barcelona, completing a work begun when the region became autonomous, has just legalized new administrative units. These units should specially interest geographers because they were devised with the modern idea of regional geography in mind all the time. Pau Vila, of Barcelona, who is the most distinguished exponent of regional geography in Spain, was the moving spirit of a Commission which the Government asked to re-frame the administrative boundaries. Consequently the Commission began by making geographical homogeneity the principle of its reorganization. The book to hand, prepared by the Technical Department of the Conselleria d'Economia, summarizes the facts taken into consideration and shows how the Commission was compelled to modify purely geographical units in order to convert them into convenient administrative ones.

An introductory review of the regional division through the centuries is accompanied by maps which indicate how, despite the ebb and flow of different ideas in Catalonia and despite stresses on widely different economic forces at various periods, the geographical regions continually peep through the political framework. Conceptions of *comarcas* or *pays* developed emphatically among the rural people. These *comarcas* persist to-day. The countryman's *comarcas* undoubtedly reflect difficulties of intercommunication which continued until well into our own century. As Vila says, "The peasant's close view of the possibilities of a piece of land and his habit of thinking that historical ties operated until yesterday have made a system of *nomes de pays* which covers all Catalonia. The *pay* may be vague in definition but it expresses the exigencies and conveniences of daily life in any area." Since the new Catalan constitution required representation which should focus these exigencies so that economics as well as politics should be defined, something of a comarcal administration was called for. Actual boundaries were, as in most of Europe, based on the fact that previously each zone had to be self-sufficing. Hence each division included different types of country so that local exchange met local needs. To-day, when cash crops are ubiquitous, such units led to regulations which, set up by local majorities, often strangled the minority of other geographical types included within the administration. The new division should be more homogeneous and avoid perpetually thrusting into the background people of the geographical overlaps. So long have Catalans been "*comarca*-conscious" that redivision on *comarca* basis formed a political plank as far back as 1897, though it only reached a practical stage in 1931.

The present Commission dates from then; it was instructed to propose the smallest number of sound regional demarcations consistent with economy and administration; to make each unit such that from each hamlet in it the return journey to the comarcal capital should be possible in a single day; to arrange the units roughly equal in population; to minimize the number of violent reorientations necessary to bring a new scheme into being.

The Commission first sent out an inquiry to each village asking to what *comarca* it considered itself to belong, what town it looked upon as its principal market town, and whether there was a secondary market town. The replies were made into two maps, one showing the *comarcas* as the villages would have them and the other the zone of influence of each market centre. The *comarca* map was interesting. Two hundred or so distinct comarcal names and units were proffered for an area of about 12,500 square miles; comarcal outliers or enclaves were extremely common. Upon this the Commission considered

no reasonable division could be made and thought the pulverization of units mostly due to pseudo-erudition.

Something of the complexity of *comarca* delimitation may be understood from the *comarca* of Priorato in South Catalonia. This is a distinct *pay* whose name is not derived from any village but from an old priory near Poboleda which was gutted some generations back. Like many other religious refuges the priory inaugurated intensive wine production in its demesne despite the difficult and broken topography. Priorato wine gained great reputation and the whole neighbourhood was laboriously terraced for viticulture. Merely to be from the Priorato zone gave a wine added value, and villages clamoured to be called Priorato villages even though they had never been part of the priory estate nor comparable to it in geographical character. The grape type which gave Priorato wine its body and high alcohol content was associated with cultivation on an inlier of Silurian schist. There was no legal force to limit the use of Priorato as a name to wines from that schist. Moreover vines on the schist lands gave very low yield while vines on other rocks adjoining gave high yield of low-grade mosto, and dealers found it convenient to use wines from the more productive areas to keep pace with the demand for Priorato wine. Unfortunately the schistose area has deep set valleys which centrifugally disperse the routes. Hence Reus, far outside the Priorato area and well into the Campo de Tarragona, became the main market town for the region. All villages dealing with Reus henceforth felt themselves entitled to use "Priorato" on their own vines. Thus an ever widening zone claimed this particular *nome de pay*. Such is the conflict when historic and agronomic factors are clear; when the factors are less precise and their produce of low value the *comarca* limit becomes even more vague. To aggravate everything most villages like to assume that their own character is unique.

Nearly seventy marketing zones were indicated by the Commission's inquiry. Deciding that these represented clear zones of attraction, where people have mutual bonds, considerable homogeneity and the necessary means of intercommunication, the Commission arranged the marketing zones in thirty-nine groups with nomenclature based on the *comarca* map, and adjusted boundary detail after consultation again with village councils of marginal localities. These were put forward as new administrative units. The *sindicatos* and collectivized units found that the comarcal units aptly fitted their own organization requirements and the new division was quickly accepted. There followed consultation with the Ministries of Agriculture, Education, and Public Health, since these primary units were to be built into secondary regions between the local and national organizations. Ultimately nine *supercomarcas* were evolved, five covering the complex coastal zone, two the interior plains, and two the mountainous northern sector.

Rationalization of agricultural life implies rational administrative subdivisions; both should be attainable without revolution. Most probably the farming interests of our own country would be far better represented if the parish groups were geographical rather than ecclesiastical or historical, for the perpetuation of the historical demarcations only too often perpetuates the historical conflicts. It is not often we are permitted to see the genesis of a new framework of local administration, and still more infrequently is the re-framing based on regional geography. Pau Vila is to be congratulated on having imposed such concepts on his political associates, and geographers in other countries will watch with interest the success of his scheme. E. H. G. D.

REVIEWS

EUROPE

THE SCENERY OF ENGLAND AND WALES. By A. E. TRUEMAN. *London: Victor Gollancz*, 1938. 7½×5 *inches;* 352 *pages; illustrations and sketch-maps.* 7*s* 6*d*

It is to be hoped that this excellent little book may find its way on to the shelves of every educated household in the country. The humanist-mathematical bias of much of our education leaves many but little aware of the nature and significance of their immediate physical environment. More is known of stars and atoms than of rocks. Yet rocks, and the scenery depending upon them, are part of the basis of daily living and the background of some of the most attractive recreations.

Professor Trueman's book is modestly addressed to "motorists and walkers as well as students." It is well fitted to serve the interests of the first two classes, and the third will hardly benefit less from its study. It is adroitly planned, beginning after the shortest of introductions with an account of the Cotswold Stone Belt. An astonishing number of valuable and basic ideas is introduced in this chapter, which is followed by accounts of the more simply constituted regions of the English Plain and then by chapters on the English and Welsh upland areas. A short concluding chapter dealing with the "Chronology of the changing scene" gives in effect a stratigraphical summary. A glossary of technical terms is included.

Though the treatment is geological it is not exclusively so. Architectural and other regional features are touched upon in so far as they are indigenous and characteristic. The book is simply and pleasantly written throughout, and while technicalities are avoided, the field is thoroughly covered. The illustrations are excellent, including many of the author's landscape sketches and some dozen simple block diagrams which should go far to smooth the path of "thinking in the solid" for the layman. All lovers of the country, in any of its aspects, will find the book invaluable and it is far from being beneath the notice of the geographer or geologist. Many must have been tempted to write such a work, if only to share the keen enjoyment which comes from an appreciation of the "pre-established harmony" of scenery. Few indeed could have discharged the task as pleasantly and adequately as Professor Trueman.

S. W. W.

COTSWOLD COUNTRY: a survey of limestone England from the Dorset coast to Lincolnshire. By H. J. MASSINGHAM. (The Face of Britain.) *London: B. T. Batsford*, 1937. 8½×5½ *inches;* viii+120 *pages; illustrations and sketch-map.* 7*s* 6*d*

The oolitic limestone uplands, that stretch from the Dorset coast north-eastwards along the Wiltshire and Somerset border through Gloucestershire, Oxfordshire, and Northamptonshire into Lincolnshire, possess certain common natural features and enjoy a common tradition of building. To illustrate these facts the publishers of this book have assembled a collection of attractive photographs, and these Mr. Massingham has connected together by a narrative that shows that he has covered the district thoroughly and has carefully noted local varieties in the construction and material of its buildings. The book is thus a fair guide to the most pleasing features of the region and an album of souvenir pictures.

One hopes that Mr. Massingham's somewhat outmoded prejudices against

classical architecture, enclosures, and the Reformation will not be taken too seriously. Nor indeed should his derivations of place-names be always relied on. Beckington, which is mentioned in the eleventh century, cannot be "christened after" Thomas Beckington, who died in the fifteenth. Moreton in Marsh has nothing to do with marches, and "guiting" means not "wood" but "torrent." Other assertions need modification. It is unlikely for instance that more than a single hundred assembled on the hill above Weston Subedge, but Mr. Massingham implies that it was the meeting-place of several. The dovecote at Ketton, "erected at the time of Domesday," is not mentioned in the survey, and even if it were, the present building could hardly have been standing in the eleventh century.

The book is written with a hyperbole that is tedious and a little misleading. Greater simplicity would have given more space, of the lack of which the author complains. But most modern topographers seem compelled to apply liliaceous epithets to the buttercup beauty of England. R. B. P.

THE CHOROGRAPHY OF NORFOLK. (An historicall and chorographicall description of Norffolck.) Edited by CHRISTOBEL M. HOOD. Transcribed by MARY A. BLYTH. *Norwich: Jarrold & Sons*, 1938. $8\frac{1}{2} \times 6\frac{1}{2}$ *inches;* vi+198 *pages; facsimile map.* 15*s*

All who are interested in matters antiquarian or topographical will welcome this first publication of a somewhat neglected unit in the series of early county descriptions, begun in the reign of Elizabeth and associated with the names of Lambarde, Smith, Norden, and others. It is nearly contemporary with these, internal evidence conclusively proving the first draft to have been begun in the reign of Elizabeth and completed by about 1610. This version was known to, and owned by, Richard Gough, and by him bequeathed to the Bodleian, while a second version, as finally put in order somewhat later, is now owned by the editor of the present volume. In her introduction and commentary she has no difficulty in showing the interest of the work, which lies not only in its substance and uncertain authorship, but in the fact that it was freely used by Blomefield for his great history of Norfolk. She shows herself well versed in early authorities like Hearne and Gough, and has evidently made careful researches among old records, though unaware, apparently, of some of the more recent contributions to the subject.

Of the two known versions, that in the Bodleian was owned by several noted collectors, including Peter Le Neve and Thomas Martin, before being bought by Gough; a companion volume on Suffolk, now lost, having also been owned by Le Neve. Martin definitely attributed the authorship to one Thomas Beckham, D.D., about whom nothing is known, and Mrs. Hood declines to accept Martin's statement. In her search for a more acceptable attribution she very naturally thinks of the noted author of other works of the kind—John Norden, and finds what she thinks is strong support for his authorship. The theory is attractive, and the MS. certainly shows strong resemblances to his work, both in form and diction, and was compiled in his life-time; but while the idea is worthy no doubt of careful attention, there are considerations which seem to weaken the argument, and some of her points, *e.g.* that both writers quoted freely from Camden, seem of no great weight. Nothing that we know of Norden connects him very specially with Norfolk, though he did carry out some surveys there. His official duties as Surveyor to the Duchy of Cornwall and royal demesnes in other southern counties, in the early seventeenth century (with his work in Ireland besides), can have left him little chance of becoming so intimately acquainted with Norfolk as the compiler of the MS. shows himself.

(Norden's somewhat sketchy volume on Northamptonshire can be shown to have been compiled before 1603 at least, in spite of the date 1610 assigned to it when finally printed.) It would surely be more likely that a Norfolk man should have undertaken the task, taking Norden's uncompleted project as a model on which to found his continuation. The Beckham family was well known in Norfolk at the time, and we find a Henry Beckham admitted to Caius College in 1601, and eventually becoming curate and schoolmaster at Dersingham. It is not suggested that this man was the actual compiler, but the family was large and a positive statement like Martin's cannot be lightly set aside, at least till we have more definite proof of agreement with Norden's own work both as regards script and paper used.

Mrs. Hood is apt to put too implicit a trust on statements by the older writers, some of which are now known to have been inaccurate, and it is a pity that she has missed some results of recent research on Norden, about whom she makes several mistakes. She dwells on the agreement of her MS. with him in the references to maps by numbers and letters, not seeing that while these in the Norfolk volume were to hundreds and deaneries, Norden's were to his own system of an arbitrary grid. She knows nothing of Norden's engraved maps of Surrey, Sussex, and Hampshire (all reproduced by the Society in 1932), and is wrong in saying that his Cornwall was the first map to show roads; moreover its suggested date of 1584 has no real support. It is a bold statement that Norden's plans (in his 'Northamptonshire') were never engraved, for there is good ground for thinking Speed's 'Peterborough' to have been copied from a lost plan by Norden. Has she, again, any warrant for speaking of the "close collaboration" between Saxton and Norden?

In spite of these defects, the volume is of distinct interest and value. It is attractively produced, and includes a reproduction of Saxton's map of Norfolk.

E. H.

SCOTLAND'S SHIFTING POPULATION, 1770–1850. By D. F. MACDONALD. *Glasgow: Jackson*, 1937. $9 \times 5\frac{1}{2}$ *inches;* viii + 172 *pages; sketch-maps.* *7s 6d*

In this work Dr. Macdonald presents the results of a very careful investigation into the changes which took place in the distribution of the population of Scotland between 1750 and 1850. The book, which is fully documented, will certainly take its place as an authority on this period. The discussions on such subjects as rural depopulation, industrial concentration, Irish immigration and Scottish emigration, and the health of the towns are full of interest for the economic historian and incidentally for the geographer. The story which the author tells, though it deals with a period during which Scotland made considerable economic progress, is not without its tragic side. Improvements in agriculture were followed by the eviction or migration of many thousands of workers on the land; the development of industry was accompanied by a great increase in child labour and by an Irish immigration which further depressed the conditions of life with evil results persisting to the present day; the growth of towns often meant unhealthy surroundings and a death rate which was alarmingly high.

Among the subjects of special interest to the economic geographer is industrial concentration. The linen industry which had once been widely distributed over the whole country was gradually restricted to the east, while in the west an important cotton industry grew up and eventually declined, in relative importance at least. Without entering into the details of these changes Dr. Macdonald appears to adopt the ordinary economic view that the linen industry

was driven out of the west by the success of the cotton industry, while the latter in its turn declined as a result of the growth of the iron and steel industry. This view is too limited. No just estimate of the decline of the cotton industry in the west can be made without taking into account the factors, geographical and otherwise, which were leading to the growth of that industry in Lancashire; similarly the development of the linen industry in the east was conditioned to a certain extent by factors other than the growth of the cotton industry in the west.

One or two statements are rather obscure. In the first pages of the book we are led to infer that it was not till 1743–55 that an approximately correct estimate was made of the population of Scotland, but a little later it is stated that the increase between 1707 and 1745 was ·3 per cent. "A line drawn from the Moray Firth to the Firth of Clyde" does not convey much to any one accustomed to maps. There is a misprint in line 10 of p. 88, where "2 deaths" should apparently be "the death." J. Mc. F.

COOK'S TRAVELLER'S HANDBOOK TO PARIS. By ROY ELSTON. New and revised edition. *London: Simpkin Marshall*, 1938. $6\frac{1}{2} \times 4\frac{1}{2}$ *inches; 154 pages; plans. 2s 6d*

The latest edition of the handbook to Paris (the previous one appeared in 1931) can be recommended for the amount of detail it contains in a brief space. In size and bulk it is handy for the pocket, printed in clear type, and provided with ample maps and plans. Apart from general information, nine itineraries are given, and there is a section on the environs.

VIENNA: the image of a culture in decline. By EDWARD CRANKSHAW. *London: Macmillan & Co.*, 1938. 8×5 *inches;* x+254 *pages; illustrations and plan. 8s 6d*

Mr. Crankshaw has unluckily been content to adhere to the terms of his sub-title. A consideration not of the image but of the substance of the culture for which Vienna stood would have been opportune, but he has not grappled with the problem. There are indications in his opening pages, when he is dealing with the geographical situation of the city, that he is not unaware of some of the reasons for its greatness. He is obviously, too, well versed in the history of the city and sensitive to the claims of its architecture and music—some of his best pages describe a golden age from Fischer von Erlach to Mozart. Very often however the book descends to the level of cafe generalizations. Identifying a civilization with a dynasty and talking of culture in terms of life and death can sometimes be entertaining, but in this case is mostly a wilfully superficial manner of evading the real issues. J. P. H. M.

DIE ENTSTEHUNG DER OSTSEE. By WERNER GIERE. (Schriften der Albertus-Universität. Naturwissenschaftliche Reihe. Band 1.) *Königsberg (Pr): Ost-Europa Verlag*, 1938. 9×6 *inches;* viii+142 *pages; diagrams and map. M.6.50*

In this monograph Dr. Giere surveys comprehensively and systematically the literature of the Baltic Sea; and, as far as existing data allow, endeavours to explain the variegated bathy-relief. With most earlier writers, he agrees that the Gulf of Bothnia is essentially a flooded portion of the Fenno-Scandian Shield, whereas the Baltic proper belongs structurally to the Russian tableland, and its most prominent feature is the submarine continuation to Gotland of the Estonian Glint line. To these two major divisions Dr. Giere adds tentatively a third, south-west of the Tornquist line (through the Västergotland coast, Skäne and Bornholm), shallowest of the three and resembling in some respects

the heart of the Baltic; but it is admitted that the thickness of drift makes it difficult here to investigate the structure.

Dr. Giere then examines the relationship of the Bothnian depression to the land areas around; and finds it impossible to accept Ramsay's theory that it is a continuation of the central Swedish depression, owing to the position of the Åland Islands swell. He proceeds to discuss the bathy-relief of the Gulf, and concludes that the presence of a mosaic of fractures and fissures (similar to that of the neighbouring embossed land surfaces) is the most reasonable explanation of the interlacing deeps. But glacial scour must be invoked to explain fully the form of the Ulvö deep and the Åland deep. The same force is held to have accomplished considerable work in the Baltic proper; for Dr. Giere finds no other agency competent to excavate the deep east of Gotland.

One other cardinal element in the author's theorizing must be mentioned. North-west of the Glint and its submarine continuation is an elongated deep, stretching from Kalmar Sound across the Baltic to the Gulf of Finland. By taking sections across this, continued to the land on both sides, it is surmised that the Shield is bent down along a line running through the south Finnish coast, the southern margin of the Åland Islands swell and the Swedish coast south of Stockholm. This flexure, then, just west of the Russian tableland, has played a leading rôle in the formation of the Baltic. Perhaps it may be regarded as the true south-east limit of the Shield.

Indubitably this is a worthy contribution to the geography of northern Europe; and will be found of utmost use to any one wishing to consult a work theoretically conservative, yet which incorporates latest data. Dr. Giere has gone over his ground thoroughly before committing himself to print; and perhaps this admirable care is nowhere better displayed than in the folding plate at the end, on which are two maps, one a new bathy-orographic map of the sea, the other an outline map showing the forty odd sub-regions distinguished on the sea-floor and surrounding lands, all of which are carefully discussed in the text.

J. H. G. L.

NEUGRIECHENLAND: eine Landeskunde Ostmakedoniens und Westthrakiens. . . . By JOACHIM H. SCHULTZE. (*Petermanns Mitt. Ergänzungsh.* Nr. 233.) *Gotha: Justus Perthes*, 1937. 11×7½ *inches;* 448+25 (*plates*) *pages; illustrations and maps. M.*24

In its method, style, and originality of subject and in its wealth of illustrations this book does honour to the series to which it belongs. East Macedonia and West Thrace, the two portions of "New Greece" which it covers, have hitherto remained one of the least-known regions of Europe. In Turkish times they were no place for wandering scholars; they were kept in a ferment by the "Macedonian question" arising from the quarrels of the local Greeks and Bulgars, and the roads were beset by brigands. In the early days of Greek ownership, the Allied occupation and the subsequent outbreak of war between Greece and Turkey equally impeded scholarly investigations.

In the happier circumstances of to-day Dr. Schultze made two journeys in 1933 through this virgin territory, the first in the spring to get a bird's-eye view, and the second in the summer and autumn to study selected details. During both journeys he "observed, photographed, drew, and measured" incessantly, and controlled his observations by conversation with all who had information to offer, conversation which preserved much knowledge that will die with the older generation of Macedonians. At home, as is shown by the extensive bibliography, he searched diligently for literature on his subject. The voluminous and varied material thus accumulated he has now marshalled

with consummate skill in clear and simple language, aiming at scientific accuracy rather than at showy hypotheses. The ensuing work rests on three pillars: the geomorphology of this region of lofty mountains fringing wide plains; the settlement in recent years of thousands of Greek refugees from Asia Minor; and the economic geography of the provinces in the past and present. He describes geological formations and the apparent absence of an Ice Age; the rivers and their winter inundations; the marshes and the malaria, the plains and the tobacco they grow; the hampering of agriculture by ignorance, primitive implements, and lack of capital; and the hills and the shrubs clothing them. He deals with the three seasons of the Macedonian year, and the contrast between the sudden storms of summer and the autumn rains, between the biting cold of winter inland and the warmth of the sea water. Finally he describes communications ancient and modern by land and sea; the difficulty in the absence of coal and iron of establishing industries; and the various peoples that dwell in the land.

Dr. Schultze repeatedly acknowledges the help he received from Greeks gentle and simple, and he compliments the Greek General Staff on their excellent revision of the map made in difficult Turkish times by Austro-Hungarian officers. He speaks feelingly of the confusion of names caused by the variety of languages spoken; as he knows neither Greek nor Turkish, the skill with which he had avoided linguistic pitfalls fills one with admiration. Only occasionally does he come to grief. For instance, consistency requires Cengel and Coban Dagh to be written either in Turkish script as Çengel and Çoban Dağ, or in German transcription as Tschengel and Tschoban Dagh; "Das Polje von Lekani" (p. 189) is tautological, *polje* being Serbian and *lekanē* Greek for "basin"; Sarisaban is not "pale place" but "yellow Shaban"; and Subaskŏj is not "das oberste am Wasser" but Subash Village (*subash* means farm steward or chief constable). With such minor exceptions the student can have nothing but praise for this remarkable book. M. M. H.

ASIA

ESCAPE FROM BAGHDAD. By CARL R. RASWAN. *London: Hutchinson & Co.*, [1938]. 9½×6 *inches; 278 pages; illustrations and route-map.* 18*s*

Mr. Carl Raswan of California is already well known in this country as the author of a very readable book 'The black tents of Arabia,' describing his life among the Badawin of the Syrian desert, with whom he had spent, on and off, before and after the war, the best part of ten years. The present work is the narrative of a journey which, he tells us, he was moved to make in the summer of 1936 with the self-imposed and laudable mission of preventing his tribal friends from embroiling themselves in the Palestine disturbances. The author is quite at home in Transjordan; his descriptions of desert scenery, customs and personalities form a vivid background of local colour for the daily adventure or hair's-breadth escape in which his unpopular activities involved him.

The chapters relating to 'Iraq (whither the author and his friend were drawn in search of "the secret leader" who "ruled the fighting squads and terror gangs" of Palestine, and whose name was "unknown even to the Pan-Arab societies") are less satisfactory, and might almost have been written by someone who had never been in the country at all. References to recent events or contemporary politics are jejune in the extreme, and other mistakes are legion, as, for example, when the marsh-dwelling Mandaeans of Lower 'Iraq are confused with the Assyrian highlanders of the north. In compensation we are regaled with all the ingredients of Hollywood melodrama, indiscreet heroes

simply asking for trouble, cups of coffee providentially refused, powerful grey cars racing to the rescue, and finally the dramatic meeting with the "secret leader" himself. Much the same applies to the account of the onward trip to Tehran which gives its title to the book.

Mr. Raswan is an expert photographer; there are some seventy excellent pictures, but of these none are of Iran and only one purports to have been taken in 'Iraq. The transliteration of Arabic and the spelling of names are strangely unsystematic and inconsistent.

Judgment must depend on whether the book is regarded as merely a thriller or as a serious tale of travel. In either case readers who enjoyed Mr. Raswan's first book are likely to be disappointed with his second. C. J. E.

A HANDBOOK FOR TRAVELLERS IN INDIA, BURMA AND Ceylon. . . . Fifteenth edition. *London: John Murray*, 1938. 7×4½ *inches;* cxxviii+792 *pages; maps and plans.* 24*s*

Mr. Murray must be congratulated on the degree to which he has kept abreast of the times in a guide-book dealing with such an immense area, where conditions are so rapidly changing and fresh discoveries are being so continually made. Generally speaking, this invaluable handbook follows the lines of previous editions. Some changes have been made in the introductory matter. For example, the subjects History and Architecture have been dealt with in a single section, instead of separately. Such a combination can hardly be regarded as an improvement. One result seems to be the omission of any connected account of Muslim architecture. The history of Buddhism and the Buddhists has been much shortened, that of the Brahmo Samaj omitted, and the account of the Mutiny drastically reduced. The index, which has been separated from the directory, contains useful chronological details, supplementing the matter in the Introduction in this respect. The use of diacritical marks in the glossary of vernacular terms is not consistent; this glossary calls for some revision. The list of words on p. cxxviii would be better described as "Etymology of some terminations of place-names in India."

In regard to the details given under "Routes," apart from the clerical errors noticed, the following suggestions are made with a view to subsequent editions. The information given about the Hathigumpha inscription of Kharavela on p. lxxxiv conflicts with that given on p. 497. The inscription is of 17 (not 117) lines, and dates from about the middle of the second century B.C. Under Elephanta (p. 26) reference should be made to Dr. Hirananda Sastri's 'Guide to Elephanta' (Delhi, 1934), which is the latest and most reliable account of the island and its remains. The ancient railing pillars in the Mahant's monastery at Bodh Gaya (p. 57) were known to be there long before Lord Curzon's time; see Cunningham's 'A.S.I.,' vol. I (1861–62). For Sarnath (p. 98) reference should be made to the revised edition (1933) of D. S. Sahni's 'Guide'; for the Indian Museum, Calcutta (p. 110), to the Catalogues, and to the 'Guide to the sculptures' (Parts I and II), by N. G. Majumdar; and for the contents of the Royal Asiatic Society's rooms, to C. R. Wilson's 'Descriptive catalogue' (1897). The Bengal Club (p. 113) was founded in 1827 (not 1825), and Fort William (p. 103) was laid out in 1696 (not 1656). In the case of Delhi we miss a reference to H. C. Fanshawe's excellent work, 'Delhi past and present' (John Murray, 1902). For the Peshawar Museum the reference should be to H. Hargreaves's 'Handbook' (1930), which has superseded Spooner's. Mayurbhanj is the name of a State, not a town (p. 493). Mahendragiri (p. 507) is not the highest point of the Eastern Ghats: there are a number of higher peaks. Under Gooty (p. 530) mention might well be made of Erragudi, 8 miles

distant, where a complete recension of the Rock Edicts of Asoka (*cf.* p. 786, *s.v.* Asoka) was found about eight years ago. For Vijayanagar (p. 575) see A. H. Longhurst's 'Hampi ruins' (Madras, 1917), and for the Madras Museum (p. 613) the excellent Museum 'Bulletins.' In the selection of books on Ceylon (p. 720) mention should be made of H. W. Codrington's 'Short history of Ceylon' (Macmillan, 1926), the only connected history of the island yet published.

The maps and plans have been carefully prepared and brought up to date; they are clearly printed in colour and above the standard usually found in guide books. C. E. A. W. O.

HIMALAYAN CAMPAIGN: the German attack on Kangchenjunga. By PAUL BAUER. Translated by SUMNER AUSTIN. *Oxford: Basil Blackwell*, 1937. 9×5½ *inches;* xviii+174+82 (41 *double plates interleaved*) *pages; illustrations and maps.* 8*s* 6*d*

The two Bavarian attempts to climb Kangchenjunga in 1929 and 1931 set a new standard of mountaineering in the Himalaya. The skill and the astonishing endurance displayed by Dr. Bauer and his companions must command the admiration of all climbers. It is good, then, to have a translation into English of the epic of these two expeditions. The story is well told, and with the directness of a man who has his reward in the experience, and not in the telling of it.

In the north-east spur of Kangchenjunga, which rises from the upper basin of the Zema glacier, the Bavarians discovered what may be the only practicable route to the upper part of this mountain, which has been examined by competent mountaineers from nearly every side. But the difficulties of the route were terrible, and the climbers had to hack their way along a sharp ridge serrated by huge towers of ice. They slept in ice-caves and worked continuously for many weeks under conditions of great difficulty and danger. In 1929 they had reached an altitude of 23,000 feet on the ridge, when they were overwhelmed by huge masses of snow, and forced to retire before raging storms. In 1931, the expedition overcame the immense difficulties of the lower ridge, and reached the junction of the north-east spur with the main north ridge, a point which may be considered to be on the upper part of the mountain. They were defeated finally at an altitude of more than 25,000 feet by a snow slope that was in danger of avalanching. But it seems evident that deterioration, due to their prolonged efforts at high altitudes, played a considerable part in their ultimate failure. This is not to be wondered at, for they had undergone a long period of incredible hardship and strain. The story of their adventure is a thrilling one, and will appeal as much to the ordinary reader as to the mountaineer.

In places the sentimental style may not appeal to readers in this country. Such passages as "But our great goal, captain, surely we won't give that up?"; and the leader's heroic exhortation to his team to pull together are apt to grate on the reader; no doubt clumsy translation has not improved these weaknesses. The author writes with a real appreciation of the beauties of the Himalaya and a genuine love for the more severe forms of mountaineering. The photographs are good and their subjects varied; the sketch-maps are simple and helpful.

The official triangulated height of Kangchenjunga is 28,146 feet, while the height of K^2 is estimated at 28,250 feet. Kangchenjunga therefore must be considered as the third highest mountain in the world, not the second as stated on the title page. E. E. S.

JOURNEY TO TURKISTAN. By Sir ERIC TEICHMAN. *London: Hodder and Stoughton*, 1937. 9×5½ *inches;* 222 (*incl.* xiv) *pages; illustrations and maps.* 15*s*

For obvious geographical reasons Sinkiang must be economically more dependent on Soviet Russia than on China or India. The natural barriers of desert

and mountain, the Gobi and the Himalaya, make any contacts with the east or south extremely difficult and to some extent artificial, while the easier natural communications with the north and west are assisted now by the line of the Turksib railway and its branches. Moreover, as Sir Eric Teichman points out, the majority of the population, the Turkis, are closely connected with the Uzbeks, Kirghiz, and Kazaks, across the Soviet border, while the Torgut tribe of Mongols have little connection with the people of China. The other important element of the population is composed of Chinese Moslems, the Tungans, but these have rarely co-operated with China and are the stormy element in Sinkiang.

It was the changed situation in this distant province after the suppression of the Tungans by the Chinese authorities of Urumchi, assisted by the Turkis, and more particularly by Soviet troops, that led, in 1935, to the despatch of Sir Eric Teichman from China to Urumchi for a consultation with the local government and with the British Consul-General at Kashgar, in order to establish contact with the new regime and to discuss outstanding questions and the possible restoration of trade. The detailed story given by the author is therefore of great interest to the student of Central Asian affairs, more particularly as it was undertaken at a time when Nanking was striving to regain a measure of control over this outlying province, and before the situation between China and Japan had degenerated into war.

There is no need to summarize here the journey from Peking to Urumchi and Kashgar by Ford V8 lorries, or from the latter place across the Pamirs in winter to Gilgit and thence by air to Delhi, for an admirable address was given by the author to the Society on 16 November 1936.[1] The careful preparation for the journey and the details of tentage and equipment, which have already been incorporated in 'Hints to travellers,' the incidents of travel, and the difficulties of the route taken are of considerable geographical interest, while a detailed itinerary is given in a valuable appendix. Routes in Central Asia do not however change rapidly and there is not a great variety in any of the different routes taken by recent travellers. The author has taken considerable pains over the correct spelling of Chinese names, and given the alternative Turki names where these exist. As regards the latter, he holds, with many other travellers to Turkistan, that the use of "q" to represent a separate sound from "k" is quite unjustifiable for words in the Turki language.

Perhaps the most interesting parts of the book are those which summarize the tangled history of the past few years and which clear up the political situation as it was at the end of 1935, though the reader cannot help feeling in places that Sir Eric has imposed on himself a reticence, necessary perhaps to a diplomat on an official mission, but one which nevertheless leaves the story not fully told. The main outlines however are there and they are enough for one to appreciate the trend of events. It almost seems that, however much the Russians may disclaim any territorial or political ambitions in Sinkiang, the recent happenings in the Far East must loosen the bonds between Sinkiang and China and strengthen those that tie the province both racially and economically to its western and northern neighbours. K. M.

DAS BERGLAND DER NORDWESTLICHEN MANDSCHUREI. By BRUNO PLAETSCHKE. (Petermanns Mitt. Ergänzungsh. Nr. 232.) *Gotha: Justus Perthes*, 1937. 11×7½ *inches;* 102+14 (*plates*) *pages; illustrations and maps. M.*12

In 1932 Bruno Plaetschke spent about six months travelling in the Great Khingan range of north-west Manchuria. In this paper he gives a brief account

[1] *Geogr. J.* 89 (1937) 297–308.

of his expeditions, and discusses what is at present known of the geology, geography, climate, and vegetation of the region. He concludes with a chapter on problems of colonization.

His expeditions were based on Hailar on the North Manchurian railway. From there he made a rapid excursion through the Barga steppe region, and two much more arduous traverses through the northern part of the Great Khingan range. He had with him a Russian, and in the Barga steppe two Polish explorers, besides three pack horses. Altogether a distance of about 1250 miles was covered, mostly on foot.

The routes followed, and what is known of the geography of the Great Khingan range, are shown on a diagrammatic map on a scale of 1 : 2,800,000. Plaetschke kept mostly west of the main watershed; he reached as far north as Okoldoi, which is probably the highest point in the range (1650 metres) and lies only about 100 miles south of Mokho on the river Amur. The original intention was to go on to the Amur, but as this proved impossible a different route was followed back to Hailar. The chief result of this expedition was to show that the previous maps needed considerable alteration.

The general character of the landscape of the Great Khingan range can be seen from his photographs. The hills are wooded, mostly with birch and larch, but the valley floors are usually open and reed-covered. A quite mature stage of erosion is indicated by the smooth slopes, poorly defined summits, and rather flat watersheds, and by the wide flat-floored valleys. The present mountain range has probably been formed by the erosion of an uplifted and warped peneplain. The author considers that the eastern margin is due to a fracture which has also determined the position of some recent volcanoes. It seems possible however that the uplift was achieved by a gentle arching, rather than by block faulting. Whichever was the case, it is now clear that the Great Khingan range is the result of a geologically recent uplift, and that it has little relation to the more ancient structural lines of the region. Certainly the structural lines do not swing round to a N.W. direction as was suggested by Suess ('Das Antlitz der Erde,' Bd. III, 1, 1901); the scanty information available about the Great Khingan range can best be interpreted by comparison with the better known Transbaikal ranges in the U.S.S.R. (see the geological map of the U.S.S.R. published for the 17th International Geological Congress, Moscow, 1937). It seems probable that in the ancient rocks which form the basement of the Great Khingan range, the "grain" swings from a N.N.E direction to an easterly direction in the northern part of the range, thus paralleling the swerve from the N.N.E.-trending Transbaikal ranges to the easterly trend of the Olekminski Stanovoi range. The relation of the Ilkhurialin range to the main Great Khingan range remains obscure. Reading Plaetschke's account, one is indeed impressed by the lack of knowledge of a region which, although desolate and sparsely populated, is of great significance for the proper understanding of the structure of Eastern Asia; this paper is a welcome addition to that knowledge. R. M. S.

THE PHILIPPINES: a nation in the making. By FELIX M. KEESING. Issued under the auspices of the University of Hawaii and the American Council, Institute of Pacific Relations. *Shanghai: Kelly and Walsh*, 1937. $8 \times 5\frac{1}{2}$ *inches;* x + 138 *pages; illustrations and sketch-maps*

This is a handbook dealing lightly with some aspects of present conditions in the islands. It does not go below the surface, nor does it give any studied account of history or modern economics. The six sketch-maps dealing with density and components of population, production, means of communication,

and the relation of the Philippines to other islands of the Western Pacific, may be found useful; other illustrations are poor. The book will not serve readers seeking carefully detailed accounts of the group. L. E. J.

AFRICA

ARTHUR RIMBAUD IN ABYSSINIA. By ENID STARKIE. (Oxford studies in modern languages and literature. General editor: H. G. FIEDLER.) *Oxford: Clarendon Press*, 1937. 9×5¹/₂ *inches;* vi+158 *pages; sketch-map.* 7*s* 6*d*

Many of those who know the African coast of the Red Sea, as well as those who do not, must from time to time have wondered how it came about that, at the outbreak of the recent Italian–Abyssinian conflict, Italy possessed Eritrea and Italian Somaliland, and what took Britain to British Somaliland and the French to French Somaliland. Miss Starkie has, by an exhaustive search among the archives of the British Foreign Office and by reading all literature published by travellers in Abyssinia during the eighteenth and nineteenth centuries, been able to produce a most instructive and readable compilation showing the happy-go-lucky foreign policies, actuated mostly by desire to keep rival powers out, that had been followed by the respective governments and that eventually placed these arid and forbidding dependencies under their charge. As early as 1879 General Gordon had advised the abandonment by Egypt of Tajura, Zeila, and Berbera as being possessions that cost her more than they were worth, and subsequent years seem only to have proved the truth of his words.

The book deals with the wanderings of Rimbaud, after he had left France to follow the life of an adventurer-cum-trader in the Middle East. In 1880, when only twenty-six, he penetrated to the fanatical town of Harar, one of the first Europeans to do so, having been preceded only by Sir Richard Burton in 1855. Rimbaud had at first been carried away by enthusiasm at the possibilities of legitimate trade with the interior, but was to find, as many disillusioned merchants have found before and since his day, that in the long run the only lucrative commerce of that coast was gun-running and slave dealing, and though he even stooped to these it cannot be said that he was very successful. R. E. C.

FELSMALEREIEN IN INNERAFRIKA: ein Bilderwerk geschichtlicher und vorgeschichtlicher Kunst. By LUDWIG KOHL-LARSEN and MARGIT KOHL-LARSEN. (Deutsche Afrika-Expedition, 1934–1936.) *Stuttgart: Strecker und Schröder*, 1938. 12×8¹/₂ *inches;* 94+XXXV (*plates*) *pages; illustrations and maps. M.*18 (*unbound M.*15)

Of recent years archaeological knowledge in East Africa has advanced by leaps and bounds, more especially in Kenya and Uganda—for Tanganyika is still largely *terra incognita* in this respect—but nowhere, unfortunately, has the rock-shelter art which is known to occur been systematically studied. A. T. Culwick published in 1931 some studies of paintings in central Tanganyika, and there have been a few other such isolated efforts; but no thorough investigations have as yet been made. This is a great pity: the various ages of the drawings, the industries with which they are associated, and the cultures to which they must be assigned are all points which require elucidation. The volume under review does not attempt to answer all these problems. A great number of sites have been studied and reproductions made, but practically no excavations or comparative work are recorded.

The German anthropological expedition was concerned with a limited area lying to the north of the central railway, round about 400 miles inland from the

coastline between Zanzibar and Mombasa. Here a considerable number of rock shelters were visited. Many of the paintings are reproduced in colour, and good photographs of the sites are also given, with excellent maps and methodically careful indications of how the sites were reached—information which it is well to have preserved in view of the great difficulties which have been experienced in South Africa in locating sites visited many years ago. We are given detailed descriptions of the paintings among which there are clearly several styles, reminding one in turn of paintings from various other areas. One amusing style has the outline of the animal figures filled in completely with bands of curving lines somewhat recalling lurid pictures of muscle-fibres in anatomy textbooks. There seems to be no means of determining any sequence in these styles nor of ascertaining the age (or ages) of the art for, with one main exception, the Mumbwahöhle, where ostrich egg-shell and bone beads and obsidian artifacts possibly referable to the Wilton or Magosian cultures were found, no excavations at the sites seem to have been made. As far as it goes therefore, and it does give us an excellent corpus of reproductions and descriptions from a new area, this book is a quite useful contribution to knowledge; but it is also an indication of what a very great deal of work remains to be done in this part of the intriguing continent of Africa. M. C. B.

DER KULTURANTEIL DES DEUTSCHTUMS AM AUFBAU DES Burenvolkes. By WERNER SCHMIDT-PRETORIA. (Sonderveröffentlichung II der geographischen Gesellschaft zu Hannover.) *Hannover: Hahn*, 1938. $9\frac{1}{2} \times 6\frac{1}{2}$ *inches;* 304 *pages; illustrations and maps. M.*8 (*bound*)

The white population of South Africa is popularly supposed to consist of English and Dutch, of whom the English are chiefly settled in the towns and the Dutch on the land, whence the latter have got their name of Boer, *i.e. Bauen* or peasant farmers. In the early days of the settlement however other nations as well as the Netherlanders contributed largely to the population. During the first seventeen years after the founding of the Settlement at the Cape by van Riebeeck in 1652 growth of population was very slow, and it was not till 1679 when Simon van der Stel was appointed Governor by the Dutch East India Company that the Cape became a real colony. Owing to the revocation of the Edict of Nantes in 1685, and even before, the Huguenots left France in large numbers and took refuge in Protestant countries where they could practise their religion in peace, and in 1688–89 several hundreds of these excellent colonists were shipped to South Africa by the Dutch East India Company and settled in the Stellenbosch and French Hoek districts. Their names and descendants still survive in large numbers in South Africa. De Villiers (often corrupted to Viljoen), Marais, Cellier and many others are well known and have many representatives still. The present volume however is concerned with the German contribution to the Dutch population in South Africa, and this is certainly the more important one. The Company had to maintain a considerable army not only in South Africa but also in the East Indies, and they found it easier to obtain recruits in Germany than in Holland. These when they had served their time in many cases settled down as farmers or merchants, and the greater part of the present volume is occupied by a chronological list of these German burghers from Michael Gleve and Paulus Petkauw who arrived shortly after van Riebeeck in 1652, to J. D. Leibbrand, who came to South Africa in 1802.

There are many of the well-known families of the Cape to be found in this list. Paul Kruger's ancestor Jacob Kröger came to South Africa from Germany in 1713. General Hertzog is of German descent, while the well-known family

of Cloete (originally Kluthe) are descended from Jakob Kluthe, who was from Cologne and came out as a cadet in the service of the Company with van Riebeeck in 1652. The information contained in the volume is largely derived from the Precis of the Archives of the Cape of Good Hope compiled by the late H. C. V. Leibbrandt and printed in South Africa, and also from other sources given in a lengthy bibliography; the whole forms a worthy contribution to the history of the growth of population and German culture in the oldest European settlement south of the Equator. W. L. S.

THE SOILS, VEGETATION, AND AGRICULTURAL SYSTEMS OF north-western Rhodesia. Report of the Ecological Survey. By C. G. TRAPNELL and J. N. CLOTHIER. *Lusaka, Northern Rhodesia: The Government Printer*, 1937. 13×8½ *inches;* x, 81+vi *pages; illustrations and maps.* 15*s*

This Report embodies the results of investigations carried out by the Ecological Survey in north-west Rhodesia since 1932. The investigators adopted the principle that in undeveloped country the natural vegetation, properly understood in relation to soil and other environmental factors and classified in consistency with them, should provide an efficient guide to that country's agricultural and forest potentialities. The Report deals with soil and vegetation distributions, correlating native agricultural systems with these. It discusses the potentialities of the various districts in regard to future development both by natives and Europeans.

The area covered lies north of the Zambezi river and west of the railway between Lusaka and Ndola. Within this region a survey of climatic, physiographic, and soil conditions has provided a basis for a classification of the natural vegetation. A map has been compiled which gives a clear indication of both soil and vegetation types. A most detailed study of native agriculture has been made. The Report emphasizes the amazing varieties in methods of cultivation, and the close association between these and the natural vegetation.

This seems an excellent method of studying the possibilities for agricultural development which exist, and of discovering how this may be accomplished without destroying the correlation between environment and native methods. It is a method which might be applied with advantage to other areas in Africa, to improve native cultivation and increase the yield of their crops.

There are unfortunately many printing errors in this Report, but it is well planned and should be a valuable contribution to our knowledge of the manner in which the African has learned to make the best of his environment. D. M. D.

NORTH AMERICA

AFTER BIG GAME IN THE UPPER YUKON. By NEVILL A. D. ARMSTRONG. *London: John Long*, 1937. 9½×6 *inches;* 288 *pages; illustrations and maps.* 18*s*

This is an admirable text-book of big game shooting in the wilds of Northern Canada for the expert and the statistician. Its value does not lie in its literary qualifications, for it is not a masterpiece of good writing, but rather in the authoritative contribution which it makes to our knowledge of the habits and peculiarities of the fauna of the Upper Yukon territory. "I have thought it desirable," writes the author, "to set down details of most of the game we came across from day to day—almost step by step—so that a picture might be gradually developed in the reader's mind of the country we were hunting and the amount of game it offered." So faithfully has this object been carried out that the most unimaginative reader will be stirred by the accounts of hardships and difficulties

overcome on the several expeditions undertaken by Major Armstrong and his friends.

The first part of the book is mainly descriptive of the country and conditions and serves as a background to the remaining three parts, which deal with three hunting trips made in 1914, 1925, and 1926. Each account not only contains detailed expositions of the art of stalking game, but is accompanied by much invaluable information on the subject of camping, equipment, and the science of "roughing it." Detailed analyses of game shot, measurements of heads, and a convincing presentation of statistics enhance the value of the book, while four carefully compiled appendices are worthy of special attention. The book is well illustrated. W. G. G.

CENTRAL AND SOUTH AMERICA

THE REPUBLICS OF SOUTH AMERICA: a report by a study group of Members of the Royal Institute of International Affairs. *London: Oxford University Press*, 1937. $9\frac{1}{2} \times 6\frac{1}{2}$ *inches;* x+374 *pages; maps.* 21*s*

This volume represents the first serious English attempt to correlate all essential facts on South America, its history and peoples, with some forecasts of their future trends. The interest and value of such a survey make it the more surprising that this task was not undertaken earlier. The British public mostly regards South America as a single entity, though it recognizes separately a few cities, such as Rio, Buenos Aires or Valparaiso. Thus it has been necessary at the outset to stress that the Continent has for over a century been divided into ten Republics, apart from the three European Guianas, and had an earlier colonial history of three hundred years; that they now number around 80,000,000 inhabitants within 7,000,000 square miles; and that Brazil, with over half this area and half the population, is Spanish neither in origin nor language, but Portuguese. If it brings only these elementary facts home to British readers, the book will have justified publication.

The term "South America" does not include everything between Mexico and the Strait of Magellan, although often used as though it did. Within these ten Republics however we are offered ample study material. The volume begins with the physical setting, the description of the effect of oceanic and air currents on the coastal climate, the Continental ground-plan and its vegetational variations being admirably clear. Then in due order come communications, by land, river, air, rail, and road; and population, indigenous and foreign, from the early Conquistadors to the African slaves, and later "swallow" immigration from Southern Europe. The chapters on the Colonial era, leading to the rise of Independence, are well presented—the writing throughout is concise and scholarly—and give a wider setting to the history of the Napoleonic Wars as well as to those of French and American Independence. The events which preserved Brazil as a Monarchy until 1889 and prevented its splitting up on the lines of Spanish America are also well brought out.

Generalized, or continent-wide, treatment by subjects and not by political divisions is adopted as the ground-plan of the book. Thus, when certain subjects overlap the Republican era, they must perforce be followed through each of ten separate variants, but the contexts in which they thus fall are assisted for reference purposes by a good index. Such subjects include economic and (separately) financial development; the land; labour and its movements; culture and education; international relations, both within and without the continent, with side-lights on six frontier disputes, not forgetting the Falkland Islands; and religion and the church. This last-named breaks much fresh

ground for English readers and also bears on the prominent part played in the conversion and tutelage of native populations by the Roman Catholic Church, which has consistently opposed their ruthless exploitation.

Group authorship results in some discrepancies, due to apparent difficulty in reconciling paper theories with actual fact. Thus, we are told that "the States having a Federal Government are Argentina, Brazil, and Venezuela; all the rest are of the military type of Republic." Venezuela and Brazil are however outstanding examples of military dictatorship, while even the present regime in Argentina continues that imposed by two successive Army leaders. Further, we read that "Constitutions of the future must correspond more closely to the realities of the situation in each country." Brazil has presented the world with two new constitutions in five years. Surely, of mere constitution-mongering we have lately had enough and to spare.

The geographical compactness of South America has perhaps led the authors to stress certain of its aspects as peculiar to these Republics, when the reverse is the case. South America was born of Europe and depends for its present economic progress on world markets. The post-war difficulties, which led to suspension of interest upon and capital repudiation of foreign loans, were not confined to South America. Every European state which took part in the Great War has defaulted here in some respect. Again, *caudillismo* and *personalismo*, *i.e.* attachment to a political leader rather than to a party platform, are phenomena even more apparent in Europe than in Argentina, Chile, or Peru.

The notes on literature, the press and music will well repay study, but in view of thirty-five pages devoted to culture and education, the scanty data given to land might well have been amplified. It is rightly noted that apart from her exported produce, agricultural or pastoral, the great bulk of South Americans are sustained by or work upon land holdings of greater or less extent. A useful addition would have been the realistic analysis of present inducements to foreign colonists and working investors, who proved so great a factor in the advance of the Argentine pampas, to settle in equally fertile and empty lands elsewhere in South America. This would have especial interest to-day, in view of the number of displaced nationals of south-east Europe and Jews.

The glossary gives some insufficient definitions. *Estancia* is more easily recognized as a stock-farm, or ranch, than as a "home-stead." *Campos* are certainly Brazilian plateau plains, but the singular noun *campo* is the common term for all non-urban areas throughout South America. Again, to describe a *bola* as "a missile weapon consisting of a thong with a stone at either end," makes one wonder whether the writer even saw that ingenious hunting device adopted by the Gauchos from the Patagonian Indians. *Bolas* are actually three stone-bound thongs, united at the centre.

Such lapses however count little against the value of this compact and varied review of South America. The appendices of statistical information are a useful sidelight, but as some date from 1934, they will require bringing up to date. Let us hope that the Study Group will not rest on its oars, but extend its work to include a review of the eleven other Latin American Republics, including Panama and Mexico, which was purposely omitted from the present volume. The map by Bartholomew is based on eleven physical contours from 1000 fathoms to 15,000 feet above sea-level, and there are nine other maps illustrating physical features and political divisions. W. S. B.

NOTES ON A DRUM: travel sketches in Guatemala. By JOSEPH HENRY JACKSON. *New York [and London]: The Macmillan Company*, 1937. 8×5½ *inches;* x+276 *inches; illustrations and sketch-map.* 12*s* 6*d*

It is a pleasure to read a book on Spanish American travel in which most of the place names and Spanish words are spelled correctly, though the accents, it is true, are too freely bestowed.

Mr. Jackson describes a rapid journey made in the course of a few weeks, through interior Guatemala. The country was entered at San José on the Pacific coast, from California; thence a motor road led to Guatemala City, and it is startling to us who knew and think of this capital as a place of unforgettable charm to read Mr. Jackson's opinion that it is "almost entirely without atmosphere." Perhaps it is not on the path of organized *turismo* that charm is most frequently encountered. But the author undoubtedly covered an unusual amount of ground, observed keenly and with unperturbed enjoyment despite discomforts, and had prepared for intelligent pleasure by careful reading.

From Guatemala City he went not only on the common roads to Antigua and Quezaltenango, but farther afield to Huehuetenango, Momostenango, Santa Cruz del Quiché and other points distant from the railway, seeking historical centres north and west of the capital. Another journey from the same starting point took him east and north-east, on a little-travelled route into the coffee country of Alto Vera Paz, to Cobán, down the Polochic river to Lake Izabal, and down the Dulce to the little port of Livingston. A short sea trip to Barrios made possible a visit to the ruins of Quiriguá—now, says Mr. Jackson, regrettably wire-fenced—before a steamer took the traveller back to the United States.

The author has a good eye for a picture, and a number of his excellent photographs adorn the pages; a useful sketch-map does duty as end-paper. The book is not deep; and it is marked by a determined facetiousness linked to tourist-agency laudation. But it is a readable and lively volume, a genuine record of a quick survey of present conditions in a country which the reviewer is glad to have travelled, years ago, in a more leisurely manner. L. E. J.

POLAR REGIONS

ARCTIC HARPOONER: a voyage on the schooner *Abbie Bradford*, 1878–1879. By ROBERT FERGUSON. Edited by LESLIE DALRYMPLE STAIR. *Philadelphia: University of Pennsylvania Press (London: Oxford University Press)*, 1938. 9×6 *inches;* x+216 *pages; illustrations (by Paul Quinn) and route-maps.* 9*s*

This book is a companion volume to one entitled 'Harpooner' under the same editorship, which was published in 1936. The earlier volume, a transcription of Captain Robert Ferguson's private diary, described a whaling voyage that lasted from 1880 to 1884. The production under review is a narrative account based on a similar, but less extensive, diary of an earlier voyage undertaken by Ferguson at the age of twenty-three as harpooner. The narrative contains little that will interest the geographer, beyond making him realize the smallness of many of the whaling vessels of the period. The *Abbie Bradford* herself had a gross tonnage of 115 tons, was 87 feet on the water-line, and drew little more than 9 feet, the ship's company numbering twenty-five in all. Sailing from New Bedford she started fishing off south-east Greenland before proceeding through Hudson Strait, and wintering at Marble Island. Robert Ferguson was clearly a fine type of man, a great lover of the Eskimo, and one could wish that his diary of the voyage had been long enough to warrant publication by itself without

the superstructure provided by the editor. Some of the incidents of the voyage are interesting, but the style of narrative and the description of men are completely unconvincing. G. C. L. B.

PHYSICAL AND BIOLOGICAL GEOGRAPHY

MOTHER EARTH: being letters on soil, addressed to Professor R. G. Stapledon. By GILBERT WOODING ROBINSON. *London: Thomas Murby & Co.*, 1937. $7\frac{1}{2} \times 5$ *inches;* viii + 202 *pages; illustrations and maps.* 5*s* 6*d*

It was a happy inspiration that led Professor Robinson to give us this most useful little book on soils in the form of a series of letters addressed to Professor R. G. Stapledon. It has enabled him to adopt an intimate style of treatment and to give a clear and simple presentation of the essential knowledge of an admittedly difficult subject. He asserts, and few geographers would disagree, that the affairs of the soil touch our lives very closely; not merely would Professor Robinson have us think rightly on such matters, but he certainly helps us to do so.

Although assailed by doubt as to whether any but a very few are interested in the soil for its own sake, he treats his subject somewhat philosophically and interests his readers in soil as a work of nature. Postulating that the master problem of crop production is that of the contract between soil and plant, he makes the book one of great value to the geographer by summarizing much information which is not readily available in convenient form elsewhere. Although not specifically written for geographers, the book is one which serious students of geography will profit by reading, for it touches on many problems of outstanding importance to them.

He explains how a soil profile bears imprinted on it the history of the soil, and introduces a useful conception of agricultural profiles to describe soils whose horizons have been markedly modified by agricultural utilization. Much that has been the empirical knowledge of farmers and gardeners is lucidly explained and clarified by a scientist who is not ashamed to enrich his text by quoting from the writings of Yeatman and Sellars.

Professor Robinson urges the need for an extension of soil survey work, which to be of real value must be carried out on the 6-inch scale and involve a mapping of soil profiles. He describes the methods of the limited amount of such work now in progress, and urges that the full usefulness of soil survey work is not reached until adequate experiments have been conducted on the potential as well as actual performance of the soils. Only then can a soil survey be regarded as an inventory of our agricultural resources. After considering some of our typical soils, the author suggests reasons why our bog and upland peat soils offer poorer prospects of improvement than most other types of waste land; geographers will scarcely be surprised that an analysis of Britain's waste lands gives little encouragement to such optimists as have hoped to see considerable improvements of them for food production. Great hopes are however entertained of the results which would follow the reclamation of our salt marshes.

The author gives good grounds for his belief that more attention might profitably be paid to improving our better land. A summary of the serious effects of soil erosion in other countries leads to the conclusion that our own soil must bear a larger share in the provision of our food, and many of the suggestions in this connection are on the same lines as the teachings of Professor Stapledon. One cannot close the book without wishing that Professor Stapledon would write a series of letters in reply. E. C. W.

WORLD NATURAL HISTORY. By E. G. BOULENGER. *London: B. T. Batsford*, 1937. 9×5½ *inches;* xx+268 *pages; illustrations.* 7*s* 6*d*

This work is a feat of unusual compression. The whole animal kingdom from Primates to Protozoa is reviewed in 256 pages. Mr. Boulenger takes up the groups successively—first mammals, then birds, then reptiles, and so on—until he ends with the microscopic Protozoa. With so vast a subject and so little space for its portrayal, he must necessarily concentrate on certain aspects of it. He naturally gives most space to the larger animals: more than 100 pages to the mammals, for instance, while the molluscs get only 7 and the Protozoa only 2. He touches but lightly on points of anatomy, while stressing those details of more general interest, such as habits, modes of life, peculiarities of behaviour. He finds space however to refer to the facts of classification, the more striking features of geographical distribution, and many matters relating to evolutionary history. Though the work is mainly a compilation, yet it also contains some original observations made by the author in the Zoological Gardens. A feature of the book are its numerous photographs, many of which are very good. R. W. G. H.

ECONOMIC AND HISTORICAL GEOGRAPHY

MARCO POLO: the description of the world. Edited by A. C. MOULE and PAUL PELLIOT. Vol. II. A transcription of Z (the Latin codex in the Cathedral Library at Toledo), by A. C. MOULE. (Printed March 1935.) *London: George Routledge & Sons*, 1938. 11½×8½ *inches;* cxxxii *pages; illustration.* Also, separately, Explanatory Note with *illustration and facsimiles of MS.*, 12 *pages.* £6 6*s. net the set of four volumes, payable in amounts of* £1 11*s* 6*d on delivery of each volume*

In 1928 Professor L. F. Benedetto published the important results of his researches into the history of the Marco Polo manuscripts ('Marco Polo: Il Milione'; reviewed in the *Geographical Journal* for March 1928). These demonstrated the value in the manuscript tradition of a Latin version used in part by Ramusio, and then lost to sight, until the discovery by Benedetto of a copy made by the Abate Toaldo in 1795. All that was then known of the fate of the original was that it had been left by the will of Cardinal Zelada to the Biblioteca Capitular at Toledo. This manuscript was called *Z* by Benedetto, and is valuable because it is derived from an older text than the best manuscript of Marco Polo, known as the Geographic Text, and preserved in the Bibliothèque Nationale.

It was announced in April 1936 that Sir Percival David had in 1932 found the original of *Z* at Toledo, and had subsequently obtained the permission of the Dean and Chapter to print it. The present volume contains a transcription of the Latin text: it is to be followed by three others which will furnish a critical apparatus, a translation, and a series of articles on special aspects of the work. The manuscript is said by experts to have been written in Italy about the year 1470. In the present publication, Professor Moule has aimed at providing "an exact representation of the manuscript, unchanged by any editing at all." The original has been copied letter for letter, except for the writing out of contractions.

In a short note which accompanies this volume, the editor states that the Toaldo copy was on the whole carefully made, but that there are certain important differences in the original. A detailed examination of this important publication may properly be withheld until the remaining volumes are published. In the meantime it is sufficient to call the attention of scholars to the appearance of what promises to be a valuable addition to the literature of geographical exploration: G. R. C.

WILLIAM TYRRELL OF WESTON. By EDITH LENNOX MORRISON and J. E. MIDDLETON. *Toronto: The Macmillan Co.*, 1937. 9×5½ *inches;* xvi+152 *pages; illustrations.* $3.00

William Tyrrell was born in 1816. At the age of twenty he went to Toronto, not as an ordinary emigrant, but as an agent to report on conditions in Upper Canada to the promoters of a projected Land Settlement Company. The reports were made but the Company never materialized, owing largely to the political unrest in Upper Canada. Tyrrell however remained in Ontario, earning his living at first as a cabinet maker in Toronto and later as a building contractor in the Humber Valley. In 1844 he settled permanently at Weston. Henceforward his time was divided between private and public activities. Although he was never successful in provincial or federal politics he played a great part in local affairs, assisted in the educational and economic development of his adopted town, and earned for himself the title of "Squire of Weston." He died in 1904. Two of his sons, Joseph and James, were explorers and geologists, part of whose activities are recorded in James Tyrrell's 'Across the Sub-Arctics of Canada.'

The authors have apparently based their work on family papers and letters supplemented by information from contemporary newspapers and by "the recollections and traditions held by the older generation still living in York County." There are no references by which statements can be checked.

T. S. W.

GENERAL

THESE ARE REAL PEOPLE. By ROSITA FORBES. *London: Herbert Jenkins*, 1937. 9×5½ *inches;* 316 *pages; illustrations.* 15*s*

From the title and general tenor of her preface to this lively and diverting book, Mrs. Rosita Forbes seems to feel that some apology is necessary for its appearance. She need not be anxious. If the reader is inspired to criticism of any kind it will be to observe that for Mrs. Forbes the length of coincidence's arm is surely exceeded only by the smallness of the world into whose dark and mysterious corners she has wormed her way. Her astonishing faculty for running across friends whom she had last seen at the other end of the earth will arouse the admiration and the envy of the most hardened globe-trotter.

This book represents the cream of seventeen years' character-sketching. Mrs. Forbes has reproduced against the background of her wide experience as a traveller a number of striking characters, the skill of whose portrayal bears witness to her powers of insight and observation. The extent to which she indulges the last-named attribute may be gauged by a quotation from one of her stories: "Some time later Jean-Jacques said to me: 'I do not know why I ask you to dine, for you neither talk, nor listen, nor eat. You just look—and not at me.' " Mrs. Forbes' capacity for observation is in fact only surpassed by her ability to extract her victim's life-story with the minimum of discomfort at the earliest possible opportunity. Only once did she meet her match—on which occasion the reader must find out for himself.

W. G. G.

THE MONTHLY RECORD

METEORITE CRATERS OF KAALIJÄRV, ESTONIA

Mr. Ivan Reinwald, Inspector of Mines in Estonia, gave in 1928 a detailed account of the results of the survey and excavations made by him of the craters on the island of Oesel. A summary of his paper appeared in the *Geogr. J.* 81 (1933) 233–234, and 82 (1933) 375. He firmly believed that the craters had been formed by the fall of a shower of meteorites, although no trace of meteoritic material could be found. These craters have been known for more than a hundred years, long before a meteorite crater was first recognized in Arizona. But since gas explosions are known from bituminous strata in Estonia (*Geogr. J.* 83 (1934) 167) some caution was necessary before the meteorite theory could be finally accepted. With remarkable persistence Mr. Reinwald returned again to the work in 1929 and 1937, publishing further papers in 1933 and more recently in *Natur und Volk* (Frankfurt am Main, 1938, vol. 68, pp. 16–24). In July 1937 he was at last rewarded by finding in two of the smaller craters thirty small fragments of much rusted meteoritic iron, the total weight of which amounted to only 100 grams. The meteoritic origin of these craters is thus at last definitely proved. Mr. Reinwald's preliminary determination of the material as being meteoritic has been confirmed in the Mineral Department of the British Museum, and an account will appear in the June number of the *Mineralogical Magazine*. Still more recently, a block of iron weighing 2·4 kg. was found when repairing the foundations of farm buildings ¾ km. distant from the main crater; but this on examination unfortunately proved to be a mass of manufactured grey cast iron.

L. J. S.

A RECENT JOURNEY IN THE RUB 'AL KHALI

We are indebted to Mr. Philby for the following account of a recent journey in the Rub 'al Khali:

During November–December 1937 two Americans (Walton H. Hoag and T. F. Harriss) of the California Arabian Standard Oil Company carried out a car reconnaissance into the northern part of the Rub 'al Khali. From the Salwa neighbourhood they went down south to Baniyan well (Banaiyan, according to Thomas) which they made their base camp. From there they went down Thomas' route to Ibrahima and Faraja, whence they proceeded to Hadida for a visit of three days, collecting material from the meteorite craters. They continued as far south as the Majari Tasrat trough, then turned north-eastward visiting the well of Daghma (probably my Tasrat well) and reaching a well which they identified as Turaiga, though their guide did not know its name. They then returned to Baniyan on a line somewhat to the east of Thomas' route. They visited Bir 'Aziz and report that the large white (*i.e.* gravel) patch should be yellow (*i.e.* sand) southward from a line drawn north-west from Baniyan, there being no break in the continuity of the sand in this tract (except for possible patches). They took no astronomical observations during this expedition, but appear to have found the R.G.S. map quite satisfactory to go by in the absence of a competent guide. South of Majari Tasrat they found the dunes too formidable to attempt with cars—they had three with them—without proper preparation.

GEOLOGY AND ARCHAEOLOGY OF THE VAAL RIVER BASIN

The "Geology and archaeology of the Vaal river basin," by P. G. Söhnge, D. J. L. Visser, and C. van Riet Lowe (*Memoirs* of the Geological Survey of

South Africa No. 35), is stated to be the result of representations made to the Dominion Government by the South African Association for the advancement of Science, and it has a dual object. The geological section comprises a study of the physiography of the Vaal river and certain of its tributaries, in itself an investigation of interest, but in a way ancillary to an inquiry into the prehistory of this portion of South Africa. It is increasingly evident that close collaboration between the geologist and the prehistorian is of the greatest importance, and the South African authorities are to be congratulated on organizing the work on these lines.

The valley of the Vaal offered great opportunities for this research, for over many miles of its course pits have been dug during the last forty years or more by diggers seeking diamonds in the alluvial deposits, and thus innumerable sections have been made available for examination. Further there can be few regions in South Africa where such a wealth of stone tools is available for study.

It would appear that there are traces of three or four separate high-level terraces marking successive stages in the development of the valley, on each of which there is found at intervals a thin spread of gravel. Reference to a section of the profile of the river (Plate IV) shows that the detached occurrences of these gravels can be correlated in a satisfactory manner. They are termed the Older Gravels and in no case do they contain the stone implements of early man, except in certain places where specimens have been introduced by subsequent disturbance. The age of these gravels is thought to be late Tertiary. At a lower level occur what are termed the Younger Gravels which in some places give rise to three terraces, the upper and older one being about 40 feet above river-level.

On the surface of the Older Gravels, but not incorporated therein, are found what are believed to be the oldest stone tools in South Africa, which in type (but not necessarily in age) may be termed pre-Chellean. They are generally fashioned by fracturing a pebble and then imposing rude chipping. Their character is quite distinct from the eoliths or the pre-Crag tools of England but the primitive man of South Africa had no flint and had to use such materials as were at hand. Working downwards in the Younger Gravels, we find a wealth of tools known as the Stellenbosch series, which gradually improve in technique as the gravel terraces become younger.

Of later age again occur the Youngest Gravels, in terraces often 22–30 feet above river-level, and in these are found two types of tools called the Fauresmith series.

Space will not allow mention of any details of the differences in the various groups, nor can we here deal with the interesting deductions regarding variations of climate during the Pleistocene and Quaternary epochs. This survey has added considerably to the existing knowledge of the Pleistocene and Quaternary chronology in South Africa, and when the detailed report on the animal remains which were collected has been published, it will provide a sound basis for the extension of work on similar lines throughout the Union, and possibly even Rhodesia.

As most workers in this field are aware, the interpretation of the comparative age of scattered alluvial deposits is one of the difficulties which are ever present, and some credit must be accorded to Professor van Riet Lowe for his avoidance of uncompromising dogmatism in regard to the evolution of palaeolithic technique, terminology, and cognate controversial points.

The memoir contains a wealth of excellent plates depicting the various stone cultures, which should prove a great help to students of the subject. C. W. H.

ROCK-FRACTURE BY LIGHTNING IN CALIFORNIA

In a paper entitled "Concerning lightning spalling," in the *American Journal of Science* for February 1938, J. D. Laudermilk and T. G. Kennard deal with the effect of lightning in disintegrating rocks in the Movahe desert to the east of Los Angeles in southern California. In order to ascertain whether or not rocks spalled by lightning could be readily found and identified, a search was made for specimens in a desert region known to be frequented by severe electrical storms. The area examined lies about seven miles north-east of Yermo near the eastern foothills of the Calico Mountains. The nearly flat desert surface is much broken up by a series of gentle ridges less than 50 feet above the surrounding ground, and the tops and sides of the ridges are thickly strewn with cobbles and boulders composed of jasper, chalcedony, silicified lava, rhyolite, and limestone. An outstanding feature of the locality is the abundance of split blocks and boulders which show percussion marks and radial flaking. The splitting of these rocks is attributed to the localized stresses produced by intense momentary heating caused by lightning. Laboratory experiments have shown that this characteristic type of fracture may be caused in brittle substances, such as glass, by localized heating, and that rocks from this locality may be split in a comparable manner by artificial lightning discharges. Hence the action of lightning is considered to be important in the weathering of exposed rocks in this region of frequent electrical storms, although the number of rocks struck per square mile of surface in each storm is not large.

The paper is well illustrated with photographs of specimens of rocks fractured naturally or artificially and a number of cases are discussed in detail. It is pointed out that one class of spalled flakes found in the district can easily be explained as primitive artifacts, but for another class the only explanation appears to be lightning.

NORWEGIAN WORK IN THE ARCTIC

No. 73 of the series *Skrifter om Svalbard og Ishavet* is a report on Norwegian work during the period 1927–1936 by the committee in Norway which co-ordinates all these activities. In most cases the expeditions concerned, to Spitsbergen (Svalbard), Greenland, Bear Island, Jan Mayen, etc., have been described elsewhere in another language; here the reports of all are collected and summarized in English to make a useful record of the diligent yet lively interest Norway takes in the arctic seas and territories. Inevitably political motives are interwoven with the purely scientific, particularly in the case of Greenland. The Norwegian work is described without reference to the Danish programme which was carried out simultaneously; a state of affairs which resulted in both countries going to great expense to make excellent air-surveys of the same stretch of economically insignificant coast between 73° and 75° N. lat.

The Norwegian mapping of Greenland by air-survey was discontinued in 1934. In 1936 it was taken up in Spitsbergen, when about two-thirds of the entire archipelago were photographed for automatic plotting. In all areas huts have been built, wireless stations installed, and numerous scientists brought to profitable fields of work. Important oceanographical observations have also been made, the soundings from Denmark Strait being particularly interesting. In reading these reports the impression is conveyed that work has been done enthusiastically for its own sake: for one thing small and uncomfortable craft have been used to transport quite large groups of explorers and their supplies. There is a valuable set of statistical appendices in this report.

Professor Lacmann has written a special account of the maps of Clavering

Island, Jordan Hill, and Geographical Society Island, to explain their construction. This is also a publication of Norges Svalbard- og Ishavs-Undersökelser, but is printed by Justus Perthes, as are also the maps. The scale of 1 : 100,000 has been chosen for these areas, although the amount of detail shown would possibly have been as clear on half the scale. The maps are elegantly produced, but well labelled with personal names which are not likely to be incorporated in the Danish official maps of the same area. Professor Lacmann's foreword describes the history of the survey and of the use of photogrammetric methods in Spitsbergen and Greenland. Single picture methods on the ground gave way first to terrestrial stereoscopic methods, and then to oblique photographs from the air. The procedure in the field and in the office is described fully and makes a very readable story of successful co-operation between Germany and Norway, which does credit both to Professor Hoel's Institute in Oslo and to the Deutsche Versuchsanstalt für Luftfahrt in Berlin.

M. A. S.

SELECTIVE SORTING OF SAND GRAINS BY WIND

In an article entitled "Shape-sorting of sand grains by wind action," appearing in the *American Journal of Science* for January 1938, Messrs. G. R. MacCarthy and J. W. Huddle present experimental evidence that the characteristic roundness of eolian sands as compared with sands of other types is in large measure due to a process of shape-sorting. The fact that eolian sands are better rounded than water-borne sands has long been recognized; but the usual explanation that such sands undergo rapid abrasion not possible in the case of the latter, because of the film of water round the grains which softens the blows, is not complete. A large sand dune at Nag's Head on the North Carolina coast, examined by the authors, is an example of field evidence of the shape-sorting of sand grains by wind action. The grains composing this dune are distinctly rounder than the grains of the beach sand from which the dune has undoubtedly been derived. The dune is only a few hundred feet back from the beach so that the distance travelled by the sand is far too short to permit rounding of the grains by abrasion. It has been shown that sands carried along a beach under the combined influence of waves and shore currents undergo a selective sorting whereby the more angular grains are shifted more rapidly than the rounder ones (*Amer. Journ. Sc.*, vol. 25 (1933), p. 205). Thus both analogy and field evidence suggest that the wind is capable of shape-sorting. The experiments described in the paper are an attempt to test the hypothesis that the wind tends to carry the round grains faster and farther than the angular grains. The sand used in the experiments with troughs and fans consisted of a mixture of very angular and very round grains, made by mixing in approximately equal proportions quartz pebbles and Saint Peter sandstone from Illinois. The sands were passed through sieves, and to aid in distinguishing the grains at a glance the crushed quartz was stained a light brown. After staining the two sands had identical specific gravities. From these experiments the authors draw the following conclusions: the wind transports sand grains chiefly by saltation; round grains on the average bounce higher than angular grains and are therefore carried farther before falling back to the ground; round grains show a strong tendency to move under the influence of wind action whereas the angular grains tend to remain behind as "lag gravels"; much of the superior roundness of eolian sands in comparison with other types of sands is due to shape-sorting. It appears, therefore, that wind and water act differently in the shape-sorting of sand grains.

THE WOLFENBÜTTEL PORTOLAN

Concerning the nationality of the cartographer who drew the portolan chart of the New World described by Dr. Uhden in the *Journal* for January, we have received the following note from Herr Heinrich Winter, of Berlin:

Dr. Uhden concludes from the form of the majority of the names and from the content of the chart as a whole that it is the work of a Spaniard. The names in the Spanish region are naturally in Spanish, just as the names in Brazil, as Dr. Uhden remarks, are in Portuguese. There is however other evidence from which the nationality of the cartographer may be determined.

The same Library possesses a chart of the Mediterranean (Aug. 101) which has the following resemblances to the chart under discussion: the representation of the mountains; the coloured coast-line; the irregular writing of the capital letters; the tendency to write L like I, and the N with the emphasis on the two vertical strokes instead of the cross-stroke; and the characteristic compass roses. The "toothed" form of the latter is well known, but here it is without the black circles or any marking of the north point; the colours are also arbitrary, for the cardinal points are in part yellow, and not, as elsewhere, blue. For these reasons there can be no doubt that the charts are by the same draughtsman, a fact which has not previously been pointed out. But if the draughtsman was a Spaniard, then the chart of the Mediterranean is the sole Spanish (non-Catalan) chart which covers the Mediterranean.

The draughtsman of the chart however reveals himself as an Italian by the spellings "braxill" and "Lvxitania," which are Venetian dialect forms. Thus Ruge wrote "Topographical names in Latin, or else Italian." On examining the original of the West Indian chart I noted Italian forms such as "Castigla" and "Fiorida." The inclusion of a "g" would be incomprehensible on the part of a Spaniard. On the chart of the Mediterranean it is correctly written "Castilia." A Spaniard would have betrayed himself by writing "Castella," not "Castigl(i)a." It was apparently on these grounds that Ruge considered the legends to be Portuguese and Italian. Space does not allow a discussion here of the signs of Portuguese which he saw. The small letters are not easily legible on my photograph; Dr. Uhden informs me that they show differences in the two charts, but this cannot alter the facts set out above.

Another point should be noted. The scale of latitude on this chart seems at the same time to serve as the line of demarcation, as on the Munich chart (Kunstman IV) and several later charts. In other cases the line of demarcation is drawn "incognito," for example on the Wolfenbüttel double chart (Aug. 104), Lopo Homem's chart of 1554, and the Turin chart, where it is the central line of the chart. The line of demarcation appears to have been an intangible feature on charts for some time. This would explain why its explicit representation on the Central American chart is omitted, although four Portuguese flags, but no Spanish, appear on it. It may be that an indication of the line of demarcation lies in the legends "Castigla del Oro" and "Tota ista provin(cia) inventa est per regem Portugallie."

NICHOLAS MIKLOUHO-MACLAY

We are indebted to Professor A. Presas, of Kellomaki, Finland, for notes upon the Ukranian traveller, Nicholas Miklouho-Maclay, the fiftieth anniversary of whose death falls this year. As the details of his life are scattered in various publications, it may be of interest to record them here briefly. The sole detailed account in English was published in Brisbane in 1882 by E. S. Thomassen.

Miklouho-Maclay, the form by which he is best known, though an accurate transliteration is Miklukha-Maklai, was born at Novgorod in 1847. He com-

pleted his education at Heidelberg and elsewhere in Germany, specializing in anatomy and zoology. After travelling in Northern Africa and Asia Minor, he joined the Russian vessel *Vitiaz* on her cruise to the Pacific. When off the north-east coast of New Guinea, Maclay resolved to make a prolonged study of the natives. A hut was built for him on the southern shore of Astrolabe Bay, and the vessel left in September 1871. He called the site of his residence Port Konstantin, after the Russian Grand Duke. The place is now known as Melanua harbour, though a Mount Konstantin still appears close by on the Admiralty charts. He also gave the name "Maclay Coast" to the surrounding country. This name is now confined to the coast some distance south-east of Astrolabe Bay.

Maclay remained here for fifteen months; after some trying experiences he made friends with the natives by a display of firmness and sympathy, aided by his medical knowledge. The people had not apparently been affected by outside influences and he was able to study their life, and to collect anthropological data. He noted the numerous varieties of Papuan stock, distinct from each other, though not separated by sharp lines of demarcation. In December 1872, he was taken off by a Russian ship which had been despatched on rumours of his murder. His health had suffered as a result of this experience, and in the intervals of his journeys during the next few years he convalesced at various places in the Dutch East Indies. After a visit to the south-west coast of New Guinea, he made two extensive journeys through the Malay peninsula, from Johore to Patani and Kedah, noting the relationship of the dark section of the population to the negritos and Andamese. In 1876 he paid a second visit to the Maclay coast, calling at Micronesian islands on the way.

His health then obliged him to seek a more temperate climate, and in 1878 he settled in Sydney. There he interested scientific circles in the establishment of a Zoological Station at Port Jackson (the building was subsequently acquired for defence purposes, the financial compensation forming the nucleus of a research fund for the University) and continued his researches in New Guinea and the islands of the western Pacific. His experiences led him to plead warmly for the better treatment of the native contract labourers, and he wished to see British sovereignty established over New Guinea. In 1883 he was in St. Petersburg lecturing upon his travels, an extensive summary of his address being published in this Society's *Proceedings*, N.S. vol. 5. On his return to Sydney he married a daughter of Sir John Robertson. He died during a second visit to St. Petersburg in 1887.

The full results of Maclay's work were never published, and his articles were contributed to many periodicals in several languages. His note books and manuscripts are preserved in Moscow. A large portion of his collections were lost while crossing the Pacific. It is difficult therefore to form a true estimate of his scientific work, but it is clear that he was a determined and enthusiastic traveller and a man of wide sympathies.

ROYAL EMPIRE SOCIETY LIBRARY

The fourth volume of the Subject Catalogue of the Library of the Royal Empire Society, produced in circumstances of peculiar difficulty, has now appeared. The three previous ones dealt with Africa, Australia, and North America and the West Indies. The present volume, though the area is geographically less well defined, takes in the sea-route to the East through the Mediterranean, and covers India, Burma, the Malay States, and the Far East generally. One notable section deals with the Cobham collection of books in many languages on Cyprus. The Indian section of the Library, though not the most extensive, contains a

representative selection of books and pamphlets on political questions, together with law reports and official publications. The entries are carefully grouped, clearly printed, and well indexed. A fifth volume, to comprise biographies, the Great War, and additions made to the Library since the previous volumes appeared, will complete the Catalogue.

MEETINGS: SESSION 1937–38

Eleventh Evening Meeting, 4 April 1938. Admiral Sir William Goodenough, Vice-President, in the Chair

Elections: Miss Patricia Backhouse; Desmond Boggs; Ian Warwick Grant Cameron; Miss Florence Ida Clark; Colin Cleghorn; Michael Alastair Fletcher Cooper, B.A.; Lewis N. Cotlow; Henry Greenwood; Noel Gurney; Miss Mary E. Odell; Mrs. Thomas Skene; The Reverend T. A. Stafford, D.D.; The Reverend Edgar White, B.A.

Paper: The Percy Sladen Expedition to Lake Titicaca. By Mr. H. Cary Gilson

Sixth Afternoon Meeting, 11 April 1938. Admiral Sir William Goodenough, Vice-President, in the Chair

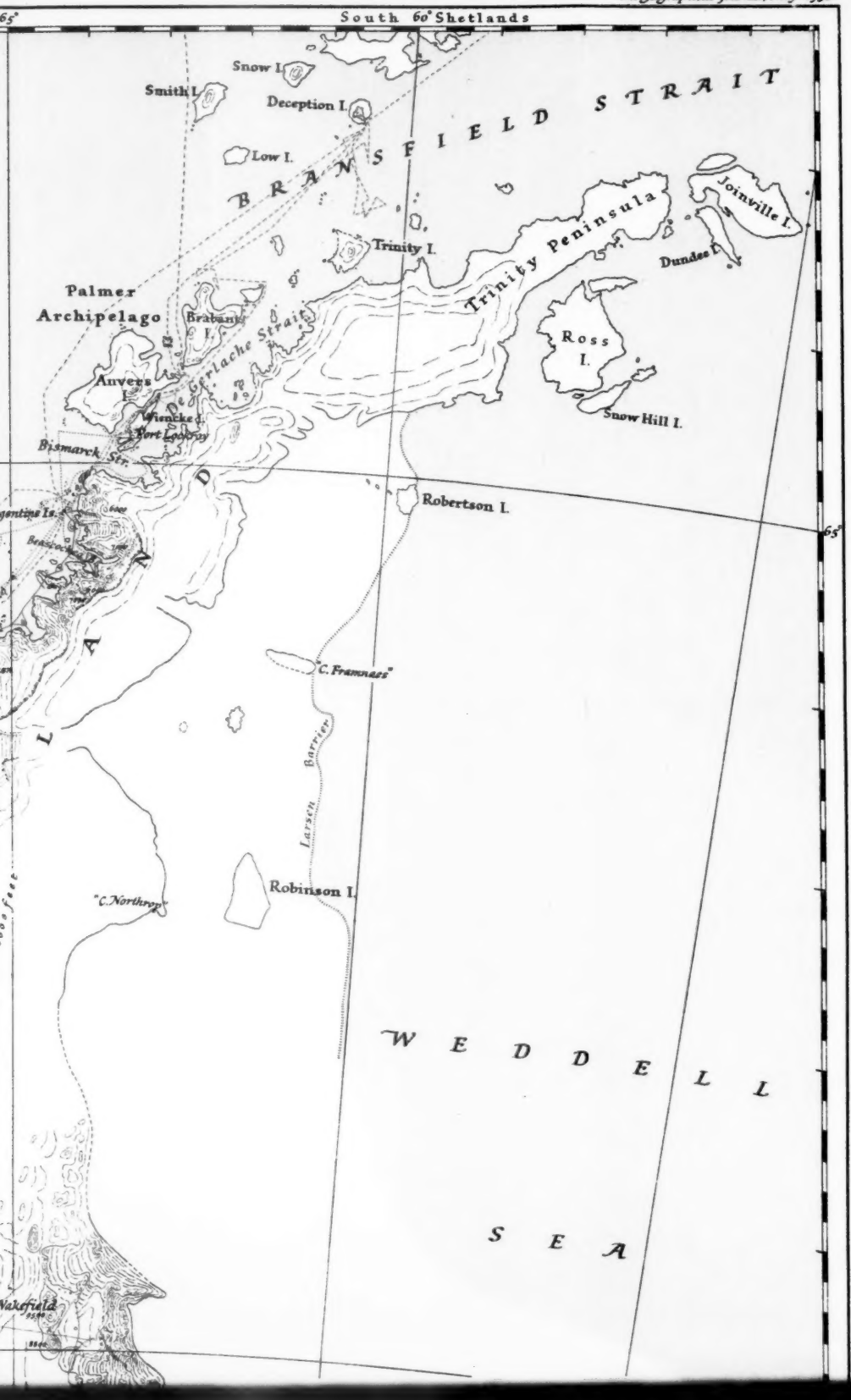
Paper: The physics of an ice-cap. By Mr. R. Moss

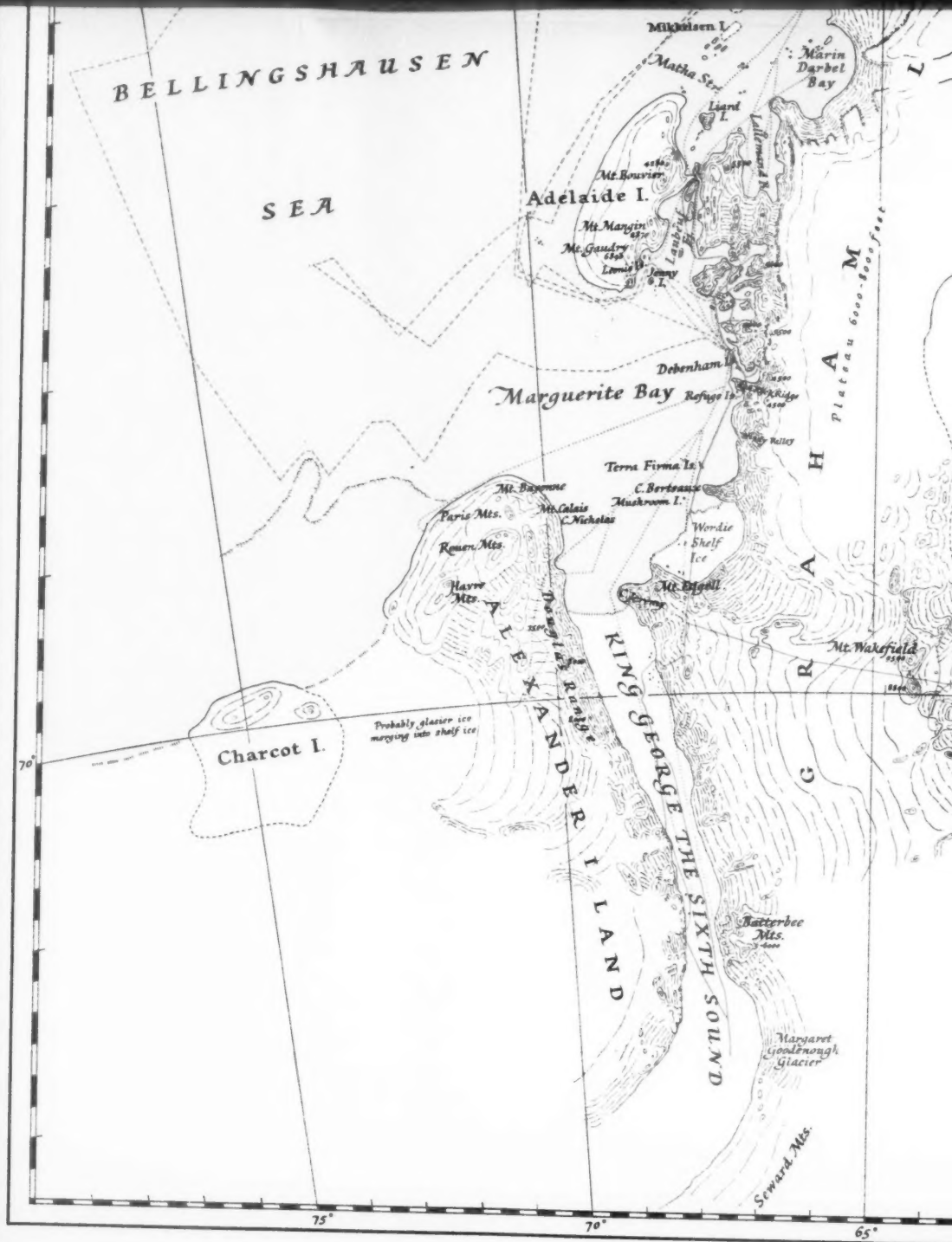
Twelfth Evening Meeting, 25 April 1938. Sir Charles Close, Vice-President, in the Chair

Elections: Miss Eileen Harriet Buckland; Captain R. A. Critchley; Henry Aird Mercer Davies; Miss Joyce de Rhonda; Russell George Frazier, M.D.; The Lady Edward Gleichen; Miss Avril Betty Everard Hannaford; Mrs. Muriel A. Hinde; Stanley Herbert Lanfear; Harold Marshall, F.Z.S.; Rev. Ralph Gerard Moir; Count de Beaufort-Molyneux; Norman J. W. E. Scott; Captain Patrick Smith; Brian Francis Kenrick Tighe; Edward Jean Louis Wenk, PH.D.; Miss Rosalie Nellie Yeates

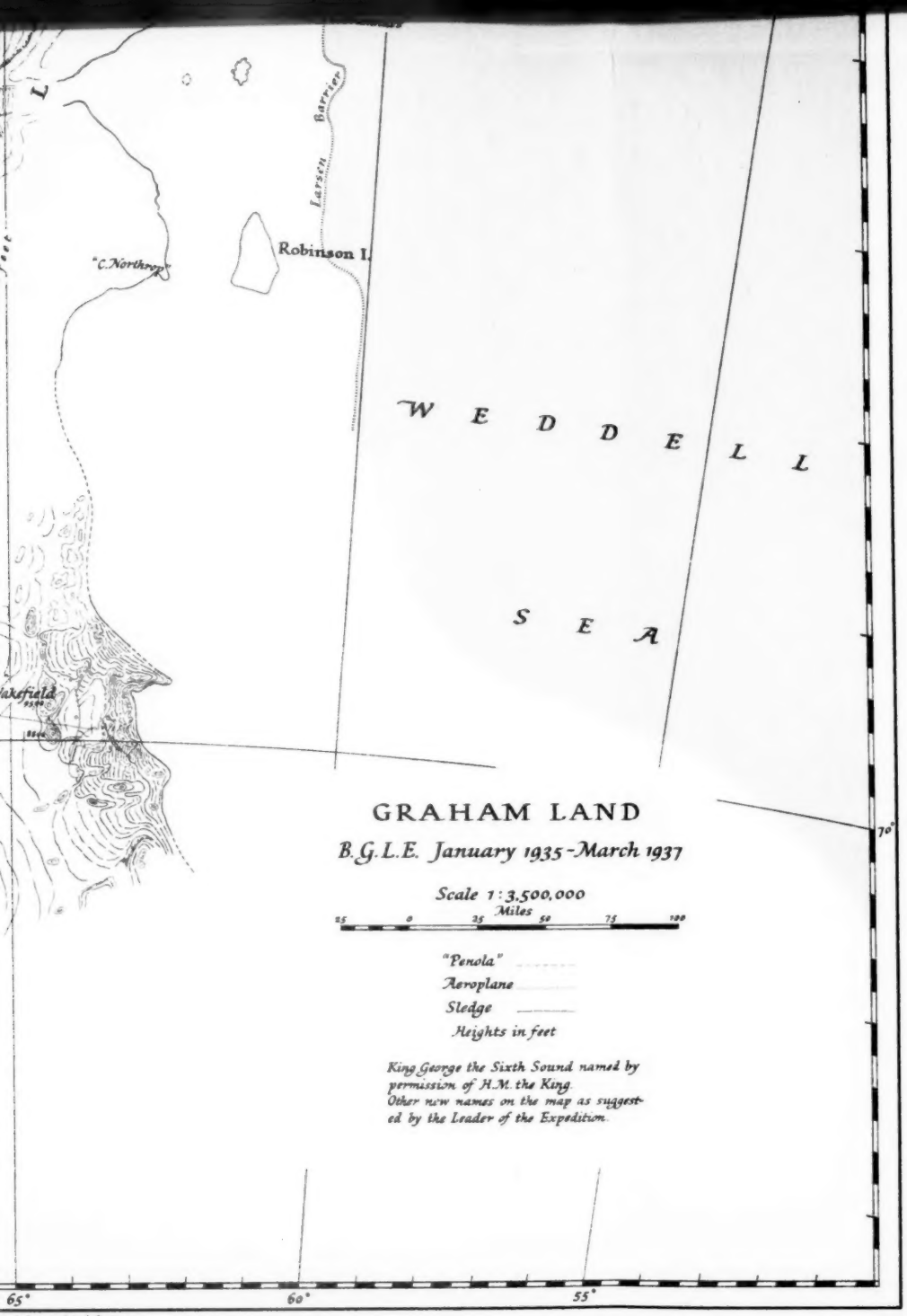
Paper: The southern Lut and Iranian Baluchistan. By Dr. Alfons Gabriel

70°
65°
65°
Victor Hugo I.
Argentine Is.
Renaud I.
Biscoe
Rabot I.
Pendleton Str.
Islands
Nansen I.
Mikkelsen I.
Matha Str.
Marin Darbel Bay
Liard I.
Lallemand
Mt. Bouvier
Adelaide I.
Mt. Manjin
Mt. Gaudry
Lemaire
Debenham I.
Marguerite Bay
Refuge Is.
Terra Firma Is.
C. Bertrand
Mushroom I.
Mt. Bayonne
Mt. Calais
C. Nicholas
Paris Mts.
Rouen Mts.
Wordie Shelf Ice
Mt. Elgoll
Mt. Wakefield
Havre Mts.
BELLINGSHAUSEN
SEA
ALEXA
RA
Plateau 6000-8000 feet
Pa
Arch


South 60° Shetlands
65°
Snow I.
Smith I.
Deception I.
Low I.
BRANSFIELD STRAIT
Joinville I.
Trinity I.
Trinity Peninsula
Dundee I.
Palmer Archipelago
Brabant I.
DeGerlache Strait
Ross I.
Anvers I.
Wienke I.
Port Lockroy
Snow Hill I.
Bismarck Str.
Robertson I.
65°
"C. Framnaes"
Larsen Barrier
Robinson I.
"C. Northrop"
WEDDELL SEA
Wakefield



Published by the Royal Geographical Soc



GRAHAM LAND

B.G.L.E. January 1935–March 1937

Scale 1 : 3,500,000

25 0 25 50 75 100 *Miles*

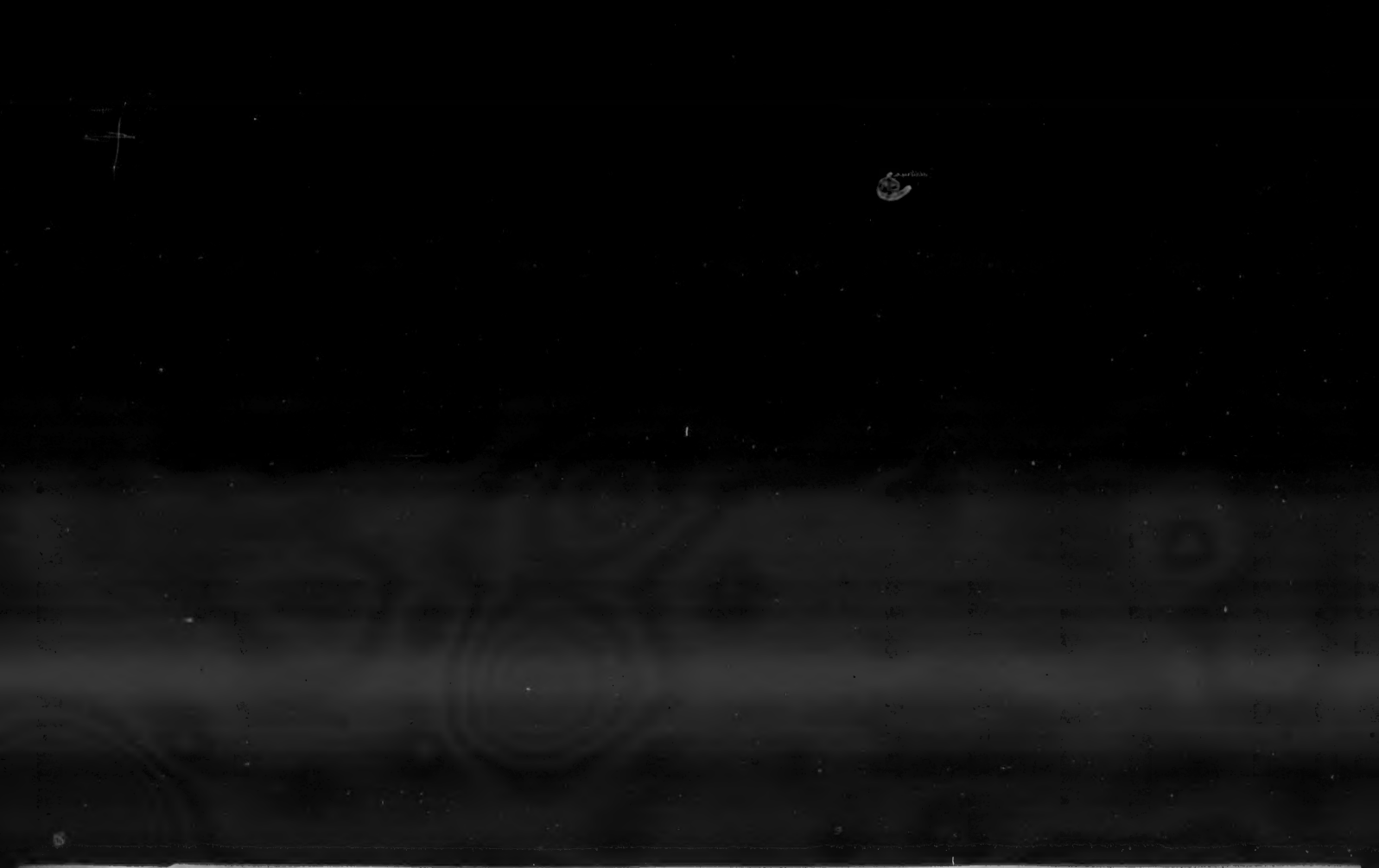
"Penola" .....

Aeroplane .....

Sledge _____

Heights in feet

King George the Sixth Sound named by permission of H.M. the King. Other new names on the map as suggested by the Leader of the Expedition.

oyal Geographical Society

BRITISH GRAHAM LAND EXPEDITION